C 57.109 : In 7/2

GLOBAL MARKET SURVEY

PROCESS CONTROL INSTRUMENTATION

U.S. DEPARTMENT OF COMMERCE/ Domestic and International Business Administration

GLOBAL MARKET SURVEY

PROCESS CONTROL INSTRUMENTATION

PENNSYLVANIA STATE UNIVERSITY
AUG 0 1 1975
DOCUMENTS COLLECTION

U.S. DEPARTMENT OF COMMERCE
Rogers C. B. Morton, Secretary

Domestic and International Business Administration
Tilton H. Dobbin, Assistant Secretary

Bureau of International Commerce
Charles W. Hostler
Deputy Assistant Secretary and Director

Office of International Marketing
Edward J. Krause, Director

JULY 1975

For sale by the Superintendent of Documents,
U.S. Government Printing Office, Washington, D.C. 20402. Price $1.90

U. S. Depository Copy

Preface

This Global Market Survey is intended to serve as an export sales planning tool for marketing decision makers of American companies engaged in the manufacture of process control instrumentation. It is a ready desk reference of facts and figures on the country markets researched and identifies the best U.S. export sales opportunities in each market on a product-by-product basis.

This Survey is one in a series of Bureau of International Commerce publications focusing on overseas marketing information for U.S. suppliers in selected industries. These Surveys are prepared by the Bureau's Office of International Marketing in cooperation with the Department of State U.S. Foreign Service and are based on research conducted in key foreign markets.

U.S. products and industries featured in Global Market Surveys are selected because of their technological or other competitive advantages in the world marketplace. Previously published Global Market Surveys are:

Agricultural Machinery and Equipment (1973)
Micrographics Equipment and Supplies (1973)
Biomedical Equipment (1973)
Computers and Related Equipment (1973)
Materials Handling Equipment (1974)
Electronics Industry Production and Test Equipment (1974)
Printing and Graphic Arts Equipment (1974)
Electronic Components (1974)
Metalworking and Finishing Equipment (1975)
Avionics and Aviation Support Equipment (1975)

For additional information on any of the above Global Market Surveys or any of the U.S. Department of Commerce export expansion programs and services, contact the Department's district office nearest you (list on page 111).

Contents

The Global Marketing Program v

Major Foreign Markets for Process Control Instrumentation 1

Country Market Surveys 8
Australia 9
Brazil 18
France 23
Germany 29
Iran 37
Italy 44
Japan 51
Mexico 59
Republic of China (Taiwan) 65
Philippines 70
Singapore 74
Spain 79
United Kingdom 86
Venezuela 95

Country Market Briefs 102
Argentina, Belgium, Colombia, Israel, Korea, Sweden, Switzerland

U.S. Government Services Available to American Exporters 107
Marketing Assistance and Information 107
Foreign Promotional Events—U.S. Trade Promotion Facilities Abroad—Country Consultants—Export Information Services—Overseas Business Opportunities—Office of Export Administration—Commerce District Offices
Financing Export Sales 112
Export Credit Insurance 113

Schedule of Promotional Events—1975 and 1976 115

The Global Marketing Program

U.S. exports reached a record $98 million in 1974, or 40% above 1973. Export business is profitable and opportunities abound as growth of foreign markets often exceeds that in the United States. Exports can increase a company's production, often with only minimal addition to overhead. Exports can contribute to business stability and counter domestic seasonal and cyclical fluctuations both in production and sales.

The Global Marketing Program, aimed at worldwide market penetration, involves medium- to long-term action by the Government in concert with 15 U.S. industrial sectors that are in a particularly advantageous position to increase export sales. Through this Program, a wide range of U.S. Government services is teamed with the extensive resources of U.S. industry to form an aggressive joint marketing effort focused on developing and expanding individual company sales in the foreign marketplace.

The Bureau of International Commerce's *Office of International Marketing* (*OIM*) is responsible for developing an effective foreign trade promotion program related to U.S. industry's needs. Other action units within the Domestic and International Business Administration (DIBA) include: the *Bureau of East-West Trade* and the *Commerce Action Group for the Near East,* concentrating special expertise and business services on the exceptional trading opportunities in these areas; the *Office of Export Development,* providing vital data on export opportunities and on potential overseas customers; and the *Office of Field Operations,* delivering all of these services to the doorstep of the American businessman through 43 District Offices.

U.S. Industries Selected for the Global Marketing Program 1975-77

Metalworking and Finishing Equipment
Avionics and Aviation Support Equipment
Process Control Instrumentation
Food Processing and Packaging Equipment
Air and Water Purification and Pollution Control Equipment
Laboratory Instruments
Business Equipment and Systems
Electric Energy Systems
Communications Equipment
Building Materials and Equipment
Computers and Related Equipment
Health Care Industries
Electronics Industries Production and Test Equipment
Printing and Graphic Arts Equipment
Electronic Components

15 Priority Industries

Fifteen American industries have been selected for inclusion in the Global Marketing Program. The selections were based on an assessment of their competitive advantages and growth potential in the world marketplace. The Office of International Marketing solicits information and assistance from each key U.S. industry and related trade associations in planning the industry programs, in developing market research requirements, and in selecting the country markets to be researched.

A Global Marketing Program combining the services outlined below is scheduled for each industry on a 3-year cycle.

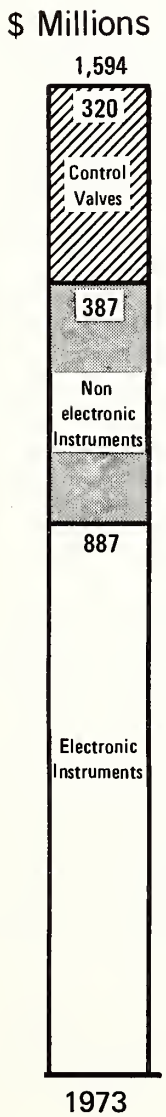
- *Foreign market research,* conducted in 20-25 countries under the supervision of OIM and the U.S. Foreign Service, is made available to U.S. firms in the selected industry.
- A *Global Market Survey,* based on the above research, is prepared and published by OIM specifically for the selected industry.
- Commerce District Office account executives provide Global Market Surveys to firms in the industry and work with them in the preparation and implementation of individual company export marketing plans.
- Country Marketing Managers assist American companies in increasing their export business in specific countries and regions of the world by providing current marketing information and by working with individual companies in promoting their products (see p. 108).
- Commerce-sponsored overseas sales promotion events are programmed over a 2-year period during each industry's 3-year cycle. Events include U.S. Trade Center Exhibitions, Trade Fairs, Technical Sales Seminars, Trade Mis-

sions, and Catalog Shows planned and implemented by the Office of International Marketing, the Office of East-West Trade Development, and the Commerce Action Group for the Near East (for descriptions, see p. 115).

Further Information

To make effective use of these and other services, contact your nearest Commerce district office (listed on page 111).

Major Foreign Markets for Process Control Instrumentation



Planned growth of overseas process industries should cause substantial increases in the market potential for control instrumentation. Sales in 14 recently surveyed foreign countries[1] are expected to rise from $1.6 billion in 1973 to about $2.3 billion in 1978 (see table 1). This would represent market growth averaging 7.7% annually, in comparison to the 4.5% rate experienced between 1970 and 1973.

The findings presented in this survey are based on on-site research conducted for the U.S. Department of Commerce. Basic research for the "Country Market Surveys" section was performed in selected countries by experienced market research companies. The "Country Market Briefs" are based on reports prepared by U.S. Foreign Service Posts.

The research reveals that the process industries are responding to the rising prices of raw materials by seeking more efficient use of resources through increased utilization of effective controls in the production process. As the prices for raw materials have accelerated, the costs associated with poor quality production resulting from improper controls have grown correspondingly. Manufacturers' awareness of these conditions have stimulated increased purchases of process control instrumentation.

The energy crisis has also helped boost the market for process controls. Plants worldwide are being remodeled so that less expensive sources of energy can be used, and dual-fired facilities are planned for the future. In addition, governments and private companies are investing heavily in new processes for oil recovery and economical sources of energy, such as synthetic natural gas and nuclear power. Experimental plants will, of course, require additional monitoring and control instrumentation.

The oil producing nations are expected to invest heavily in developing new process industries. They hope to establish broader industrial bases through long-range development and diversification of their economies over the next several years. They are building refineries and petrochemical complexes in order to substitute exports of intermediate products for crude oil. Producers in these countries are seeking the most technologically-advanced instrumentation available. Typical of the activity taking place in the petroleum

[1] Australia, Brazil, France, Germany, Iran, Italy, Japan, Mexico, Philippines, Republic of China (Taiwan), Singapore, Spain, United Kingdom, Venezuela.

and petrochemical sectors are:

- The Venezuelan Government has given high priority to the development of the petrochemical sector. The National Petrochemical Plan calls for investment of $2.2 billion over the next 10 years. Four petrochemical complexes will be built.
- The Iranian Fifth Plan allocates almost $2 billion for investment in natural gas projects between 1973 and 1977. Approximately $1.4 billion will be spent to build liquified methane plants. Most of the methane produced will be exported.

Many of the oil importing countries currently face foreign exchange shortages. In an effort to reduce trade deficits, these nations are placing increased emphasis on expanding production of the process industries in an effort to satisfy domestic demand as well as provide a surplus for export.

- German oil industry managers have set a target date of 1980 for self-sufficiency in refined petroleum products. Local refineries, which produced 133 million tons in 1972, were unable to satisfy a domestic demand that exceeded 175 million tons. Demand is expected to rise to 200 million tons a year by 1980.
- The Japanese primary metals industry has extensive investment plans for the blast furnaces and basic steel mills sector. Crude steel capacity was 130 million metric tons (MT) in 1974. The industry predicted that 160 million MT will be required in 1980. Foreign exchange earned from the export of steel will be needed to pay for Japan's growing imports, including those of more expensive petroleum.

Table 1.—Size of Market for process control instrumentation by country, 1970, 1973 and projected 1978

(in millions of U.S. dollars)

	1970	1973	1978
Australia	40.5	53.6	66
Brazil	16.1	25.0	50
France	107.5	181.9	215
Germany	342.7	496.6	745
Iran	22.9	46.0	108
Italy	109.4	170.3	174
Japan	220.3	314.1	552
Mexico	22.0	36.2	59
Philippines	1.7	2.4	6
Republic of China	2.5	7.5	15
Singapore	4.3	8.4	12
Spain	53.1	61.1	78
United Kingdom	175.4	175.7	190
Venezuela	11.8	15.0	32
Total	1,130.2	1,593.8	2,302

Source: Bureau of International Commerce, Office of International Marketing research studies.

U.S. Holds Leading Position

The United States is by far the dominant world supplier of process control instrumentation. In the 10 countries for which a market share breakdown is available, U.S. manufacturers in 1973 supplied 34% of imported process control instrumentation for a value of nearly $157 million (see table 2). Trade experts predict that in 1978 approximately 43% of imports should come from the United States.

Much of this growth will occur in sales of electronic instruments. Borrowing from the U.S. electronics industry, which is developing new technology at a faster pace than that of other countries, American manufacturers are able to offer superior instruments. U.S. firms have also led in developing direct digital control systems for the process industries.

Sales of electronic instruments in the 14 countries surveyed have grown at a faster pace than those of nonelectronic instruments. This trend is expected to continue during the 1973-78 period, with the market for electronic instruments climbing at an average annual rate of 8.2%. The growth of sales of nonelectronic controls is expected to average 5.4% per year. Purchase of control valves are forecast to expand by almost 8% annually during the same period.

The Department of Commerce estimates that U.S. production of process control instrumentation totaled $1.8 billion in 1974. Some $1.1 billion of this represented output of electric and nonelectric instruments, and control valves accounted for the remaining $700 million (see table 3).

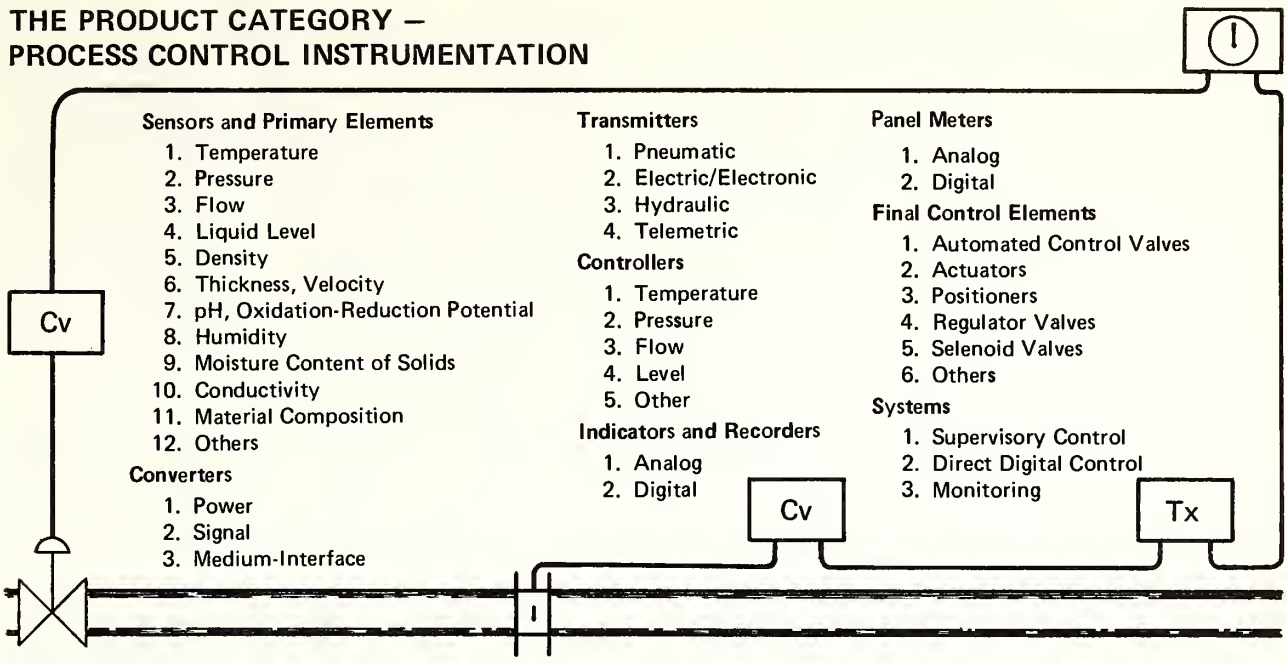
Although production of process controls decreased between 1970 and 1972, exports rose steadily. U.S. sales abroad of process instruments (excluding control valves) rose from $158 million in 1970, representing 21% of production, to $168 million in 1973, for 27% of output.

Most of the instrument manufacturers entered 1974 with substantial backlogs of orders. Though backlogs were beginning to decrease in the first quarter of 1975, trade specialists predicted the industry will operate at maximum capacity at least through 1975.

European suppliers offer stiff competition in the world market. Germany holds a strong position in its own market and is second only to the United States in exports of process controls. Export sales accounted for roughly 31% of local production in 1970. The bulk of foreign sales are transacted in conjunction with complete refining and processing facilities that the German chemical and metals industries install abroad.

Siemens AG and Hartmann and Braun are leading German exporters. They produce highly sophisticated instruments that compete successfully in the world market.

THE PRODUCT CATEGORY — PROCESS CONTROL INSTRUMENTATION



The United Kingdom exported approximately one-third of its production of process control instrumentation in 1969. The George Kent Group is the largest domestic manufacturer, with eight plants and over 5,000 employees producing a wide range of process controls. Their "Flexel" electronic controller systems and "Introl" valves are highly regarded in the world market.

Other foreign competition comes from Italy, Japan, and France. The Italian firm Nuovo Pignone is one of the world's largest producers of control valves. Japanese firms have formed joint ventures with U.S. and other process control instrumentation manufacturers. These joint ventures are successfully selling throughout the Far East. France exports one-third of its domestic production.

The Customers

Recently conducted research surveyed seven to 10 industries in each of the 14 countries. Of these, four were consistently reported as offering outstanding sales opportunities for process controls manufacturers.

Chemical Industry. Process control instrument sales to the chemical industries totaled almost $260 million in 1972 and are expected to exceed $560 million in 1978 (see table 4).

Worldwide demand for chemicals, particularly industrial organic chemicals, is growing at an unprecedented rate. Trade sources predict that sales by the U.S. chemicals industry will rise by over 10% in 1976.

Prices for organic chemical products, which had been held down during the 1960's because of overcapacity, have risen sharply in the first half of the 1970's. Recent price increases have stemmed from the growing price levels of oil, a major material feedstock, and higher levels of demand.

The demand for plastic and plastic products is expected to grow despite higher prices. Other materials are rising in price concurrently, often at higher rates, and the superior performance of plastics for many applications will continue to be a major consideration.

The organic chemicals sector is modernizing and expanding its facilities in many of the surveyed countries. According to the research, instruments and controls particularly needed by the sector in the 1975-78 period include on-line gas chromatographs, infrared analyzers and related transmitters and receivers, analog electronic control systems, minicomputer-based control systems operating mainly in the data logging or supervisory mode, pH redox meters, pyrometers, turbidity meters, and air and water pollution continuous monitoring instruments.

Rising prices for chemical products have spurred interest in expanding production facilities. Development plans and other major projects that point to increased sales of process control instrumentation in separate countries are numerous. Typical indicators include:

- *France:* Five new chemical processing facilities will be completed by 1979 at a total cost of $300 million to $350 million. Each plant will have approximately 200 closed loops and will utilize on-line analyzers and supervisory computers.
- *Iran:* The Iran-Japan Petrochemical Company will build the largest chemical processing complex in the country. Total investment in the project is expected to amount to approximately

Table 2.—Imports and U.S. share of imports by country,[1] 1973 and 1978
(in millions of U.S. dollars)

	1973			1978		
		U.S. share of imports			U.S. share of imports	
	Imports	value	percent	Imports	value	percent
Australia	46.6	22.2	48	58	28	48
Brazil	24.0	10.9	45	47	19	40
France	178.9	27.3	15	205	72	35
Germany	121.2	30.7	25	205	58	28
Japan	34.5	28.5	83	69	57	83
Mexico	29.9	22.4	75	38	29	75
Philippines	2.4	1.5	62	6	3	49
Republic of China on Taiwan	7.4	2.3	31	15	4	27
Singapore	9.6	2.3	24	14	3	24
Venezuela	14.2	9.3	66	29	19	64
Total	468.7	157.4	34	686	292	43

[1] Data was not available for Iran, Italy, Spain and United Kingdom.
Source: Bureau of International Commerce, Office of International Marketing research studies.

$800 million. The installation will produce a wide variety of chemicals, including ethylene dichloride, vinyl chloride monomer, polyethylene, benzene, cumene, caustic soda and paraxylene.

- *Venezuela:* Construction of the first stage of the El Tablazo Project, scheduled for completion in 1975, will involve five different companies and multiple plants. Annual output will amount to 1.2 million tons of diverse products valued at roughly $140 million. Total investment planned for the first stage is $445 million. Completion of the second stage is scheduled for 1976 at a cost of $500 million. The entire project should be finished by 1980.

Utilities. Although the rapid rate of growth experienced by utilities in the past few years is expected to decrease slightly during the 1975-78 period, the industry will remain one of the most important purchasers of process control instrumentation. Sales of automatic controls in the 14 surveyed countries in 1978 are expected to total almost $460 million. a 92% rise over the 1972 level of $240 million.

The electricity generation and distribution sector will account for a substantial portion of sales of control instruments. Trade specialists predict that modern industrial societies will become more dependent on electricity as a source of energy in the approaching decades. Electricity has one advantage in that it can be produced from a greater variety of fuels and natural sources than any other energy form. In addition, pollution would be a lesser problem if cities were powered by electricity and generating facilities located in rural areas. Most combustion by-products and emissions can be controlled more effectively when produced in a single plant.

Table 3.—U.S. Production of Process Control Instrumentation
(in millions of U.S. dollars)

	1971	1972	1974
Electric and nonelectric instruments	720	630	1,100
Control valves	500	530	700
Total	1,220	1,160	1,800

Source: U.S. Department of Commerce estimates.

The major problem faced by electrical power utilities is the rising price of fuel. In the early 1970's many facilities switched from coal to oil. Coal is relatively inexpensive and in most countries readily available, but oil is cleaner burning. Now, as a result of the sharp rise in the cost of petroleum, many utilities are planning new generating facilities which will be coal fired. However, since public pressure is growing to maintain strict standards on air quality, most new facilities will contain sophisticated monitoring and control systems.

Nuclear powered generating stations offer many advantages over the more traditional fossil-fueled plants. Experts agree that nuclear facilities offer the most economical source of energy, particularly during the period of rising costs of fossil fuels. Moreover, nuclear facilities are less damaging to the environment than most other sources of energy.

Light water reactors are in general use in the United States and other industrialized countries. However, high-temperature gas-cooled reactors are expected to play a major role in future power generation. While research has increased recently in the development of the more efficient fast-breeder reactors, these systems are not expected to be in operation before the end of the century.

Advanced process control instrumentation will be in increasing demand by this sector. Items that will be in particular demand include: Neutron instrumentation systems, isolation valves, safety valves for

emergency shutdowns, leak detectors, seismic analyzing equipment, chromatographs, viscometers, steam/condensate analyzers to measure pH, conductivity, dissolved oxygen and silica content.

Typical programs in various countries include:

- *Republic of China (Taiwan)*: Two nuclear power plants, each with capacities ranging from 900 to 950 MW, are planned for construction at a cost in excess of $800 million. Startup is scheduled to begin in 1981 and 1982. Two 1,300-MW plants are planned for completion in 1984 and 1985. The latter facilities should involve a total cost of over $1 billion.
- *Italy:* The national electricity authority foresees that over the next 5 years 15 new power plants will be needed to satisfy demand for electricity. The 11 proposed new thermal stations include three 1,250-MW plants, each costing about $180 million and having 140 closed loops; two 2,600-MW stations using 160 closed loops per facility, five 600-MW stations, and one 300-MW unit. The electricity authority also plans to construct four new nuclear plants at a combined cost of almost $2 billion. Each of the 950-MW stations will use an estimated 300 control loops.
- *Philippines:* Two experimental geothermal generating plants are being constructed in Tiwi by Philippine Geothermal Inc., a subsidiary of Union Oil of California. If results are favorable, two additional 25-MW units will be erected by 1978.

Petroleum Industry. The petroleum industries in the surveyed countries are expected to purchase process control instrumentation in 1978 valued at $274 million, an increase of 76% over the 1972 level of $155 million.

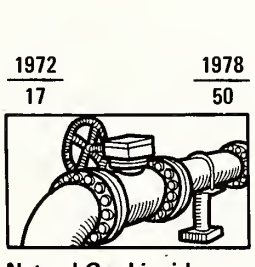
Despite recent increases in the price of crude oil, worldwide demand for petroleum continues to mount. Oil is and will remain, at least through the end of the century, the primary source of energy throughout the world. Industrial expansion is dependent upon increased use of refined petroleum. Furthermore, increased productivity requires the substitution of machines for manual labor, and fuel is required to make the machines as well as to operate them. Also, the chemical industry, one of the largest volume purchasers of refined oil, continues to grow.

The most serious concern of the petroleum refining sector is the availability of crude oil. World petroleum production in 1973, was estimated at 55 million barrels per day, an 8.8% increase over the 1972 level.[2] The petroleum industry is making an intensive effort to locate and develop new oil fields. In addition, higher oil prices have resulted in the opening of capped wells and has made marginal wells profitable.

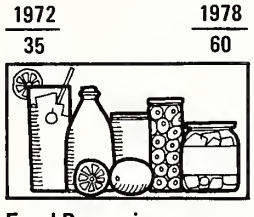
[2] Data based on report in Oil and Gas Journal, Dec. 31, 1973, pp. 85-87.

SALES OF PROCESS CONTROL INSTRUMENTATION TO MAJOR INDUSTRIES IN SURVEYED COUNTRIES

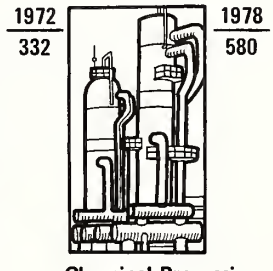
(in millions of U.S. dollars)



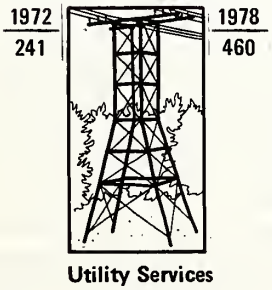
Natural Gas Liquids



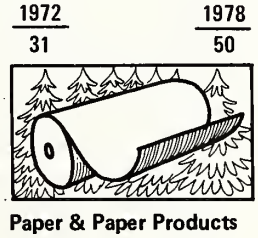
Food Processing



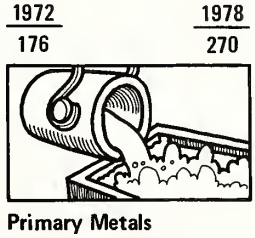
Chemical Processing



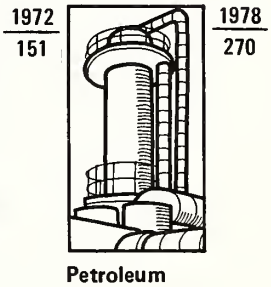
Utility Services



Paper & Paper Products



Primary Metals



Petroleum

Table 4.—Industry sales and consumption of Process Control Instrumentation (PCI)
(in millions of U.S. dollars)

	Petroleum Industry			Chemical Industry			Utility Services Industry			Primary Metals Industry		
	Sales	Consumption of PCI		Sales	Consumption of PCI		Sales	Consumption of PCI		Sales	Consumption of PCI	
	1972	*1972*	*1978*	*1972*	*1972*	*1978*	*1972*	*1972*	*1978*	*1972*	*1972*	*1978*
Australia	373	4.7	5.3	1,823	7.0	10.5	1,952 [1]	12.7	15.1	3,164	10.8	13.2
Brazil	8,542	5.2	12.5	3,545	4.3	11.0	n.a.	1.5	2.5	1,254	3.6	10.5
France	4,996	19.5	25.4	7,142	62.4	76.0	3,568	12.6	18.5	6,423	11.7	13.6
Germany	5,870	20.4	44.7	17,955	79.0	152.7	8,647	91.6	193.7	24,205	18.9	39.5
Iran	n.a.	3.9	15.3	4,184	4.8	27.3	6,145	3.1	22.5	3,175	12.7	17.7
Italy	2,047	22.0	10.1	5,291	53.2	68.8	3,155	18.2	24.5	4,367	45.6	32.3
Japan	10,208	43.2	107.6	16,584	62.2	154.6	7,662	34.8	82.8	29,629	32.7	82.8
Mexico [2]	1,062	8.3	19.8	441	2.6	5.2	495 [3]	2.8	6.6	410	1.8	5.4
Philippines	200 [4]	.4	1.2	370 [4]	.3	.9	n.a.	.4	1.3	152 [4]	.3	1.3
Singapore	665	3.5	6.3	58	.4	3.7	n.a.	.8	1.5	n.a.	.1	.4
Taiwan	200	2.8	5.5	459	1.2	3.8	n.a.	1.2	3.8	3,124	.0	.3
Spain	1,000	5.1	2.0	4,752	11.9	16.4	1,373	16.7	27.0	3,124	13.3	15.6
U.K.	3,505	13.2	11.4	10,065	39.5	38.0	7,185 [5]	42.8	55.1	9,770	23.0	34.2
Venezuela	2,149	3.2	6.4	418	2.5	8.0	208	1.3	3.2	225	1.0	3.8

[1] 1970 data.
[2] 1970 data for industry sales.
[3] Electricity generation and distribution sector only.
[4] 1973 data.
[5] 1971 data.
Source: Office of International Marketing research studies.

According to the *Oil & Gas Journal,* refinery capacity for all areas of the world, exclusive of Eastern Europe and the People's Republic of China, is expected to expand from over 53 million barrels per calendar day (b/cd) in January 1974 to 57 million b/cd in January 1976. Western Europe will account for 18.6 million b/cd; the United States and Canada, 17 million b/cd; Latin America, 7.5 million b/cd; the Middle East, 3.2 million b/cd; the Asia-Pacific region 9.3 million b/cd; and Africa, 1.4 million b/cd.

Hydroprocessing is the most widely used method for refining crude oil. Western Europe refined over 5 million b/cd by this process in 1974, while catalytic reforming accounted for almost 2.1 million b/cd. The catalytic cracking method has recently gained widespread use and over 1 million b/cd were refined in this way in Western Europe in 1974.

Refining companies are expected to purchase the most advanced process control instrumentation as they seek to obtain optimum production from their facilities. Purchases should include direct digital control systems, on-stream analyzers for oil distillation products, on-line digital blenders, automatic line-up sequence systems, and man-machine communication systems, including chart and character display devices and operators console systems.

Typical projects in the industries are outlined below:

- *Mexico:* Domestic refinery capacity will be expanded in the next few years as a result of the estimated 12-14% annual increase in demand for petroleum. Mexico's petroleum needs should amount to 835,000 barrels per day (bpd) in 1976, a 60% increase over the 525,000 bpd needed in 1972. The new refinery at Tula will help satisfy the growing demand. When completed in the late 1970's at a cost of $292 million, the plant will have a capacity of 300,000 bpd.
- *Brazil:* Construction of a new refinery at Araucaria with a capacity of 125,000 bpd is scheduled to begin in 1976. Another refinery at San Jose dos Compos will have a capacity of 189,000 bpd when completed in 1978.
- *France:* During the 1974-78 period, the petroleum industry plans to build four new refineries, with a combined capacity of 16 million MT per year. Each plant will cost between $100 and $150 million and will contain 250 control loops. The plants should utilize on-stream analyzers and supervisory computer control systems.

Primary Metals Industry. The primary metals industries are also major purchasers of process control instrumentation. Sales to the industries in the survey countries are expected to rise from $175 million in 1972 to $270 million in 1978.

Blast furnaces and basic steel mills form the largest sector within the primary metals industry. World production of steel set new records in 1973, when production of raw steel totaled 754 million tons. Output in 1974 is expected to decline slightly.

A rapid rise in demand for steel began in 1972, when general economic prosperity resulted in increased purchases of automobiles and consumer appliances. As capital spending increased, orders rose from the railroad, construction, and machinery in-

dustries and demand was strong for virtually all steel products. Since then, the rising prices of fuel oil and gasoline have resulted in a decline in sales of automobiles and other consumer durables. However, demand for steel from the energy industries is partially offsetting this decline.

The oil and gas industries abroad will require steel for increased drilling activity, for more pipelines for transportation, and for the construction of new refineries. An increase in coal output will require more steel for mining and for mining equipment. Steel will be needed for the construction of electric power plants, including nuclear facilities.

Steel mills in industrialized nations are likely to purchase sophisticated, technologically-advanced process control instrumentation. According to the research, instruments that offer excellent sales opportunities to U.S. manufacturers include: Supervisory and direct digital control systems; process gas chromatographs, especially for continuous monitoring, testing equipment to detect oil stain, contamination patterns, or blemishes on fast moving steel strips; paramagnetic and infrared on-line analyzers, high temperature probes; and nucleonic equipment for level of molten steel, density measurement, and weighing and gaging thickness of steel strip and coatings.

Expansion plans in several of the surveyed countries include:

- *Italy.* Italsider SpA expects to spend nearly $500 million between 1974 and 1980 to improve and enlarge its Toranto steelworks. Capacity will be expanded from 6 million MT per year to 10 million MT. Plans include five blast furnaces and associated basic oxygen furnaces (BOF), continuous casting machines, reheat furnaces, soaking pits and strip mills. The steelmaking process will be controlled by 25-30 closed loops regulating each blast furnace, 15 loops used with each BOF, 15 loops for every continuous casting machine, 30 loops per reheat furnace, and 6 for each soaking pit.
- *Spain.* Expansion plans include the construction of an integrated steelworks which will use blast furnaces with oxygen converters, four direct reduction mills, a steelworks at Irurzun and a new tube mill at Sanguesa.
- *United Kingdom.* The British Steel Corporation expects to spend $75 billion between 1973 and 1982 for the construction, expansion and modernization of basic steelworks at six major sites. Stage two of a complete new steelmaking complex will be started in 1975. The corporation will invest an estimated $125 million in an ore terminal, sinter plant, pelleting plant, coke ovens, blast furnace and power station.

The overseas markets for process control instrumentation offer potentially lucrative sales opportunities for U.S. manufacturers. Foreign customers report that American companies could increase their sales through a more concentrated marketing effort. Some U.S. companies, recognizing this, have sharply increased their participation in the international market and secure as much as 40% of their total sales from abroad.

The following basic steps are suggested for firms seeking to initiate penetration in foreign markets:

- Establish effective sales representation abroad
- Participate in overseas trade exhibitions
- Provide for sales and technical literature written in appropriate languages.
- Advertise in trade publications and contribute articles to trade journals.
- Maintain delivery commitments and effective aftersale service.

The Department of Commerce can assist U.S. manufacturers of process control instrumentation in capturing a greater share of the overseas market. Export information services supplied by the Department are listed and explained on page 109. Companies interested in obtaining more information on the listed programs should contact the nearest Department of Commerce District Office.

Under the Brussels Tariff Nomenclature (BTN) the Standard International Trade Classification (SITC) and the Standard Industrial Classification (SIC) systems of commodity classifications, there are no categories exclusively limited to process control instrumentation. Statistics used in the survey are trade source estimates based on the following classifications.

	BTN	SITC	SIC
electric instruments	90.28	729.52	
nonelectric instruments	90.23 90.24 90.25 90.29	861.96 861.97 861.98 861.99	38230
control valves	84.61	719.92	34941

Country Market Surveys

Surveys on 14 primary country markets for process control instrumentation are contained in this section. These surveys are based on comprehensive on-site market studies conducted for the U.S. Department of Commerce in the respective countries.

The *Country Market Surveys* emphasize product areas in the market for process control instrumentation as follows:

- Electric/electronic instruments
- Nonelectric/nonelectronic instruments
- Automatic control valves

Market Size

- Narrative and statistical presentation of size of the market for process control instrumentation, including historical and projected growth
- Discussion of imports and the U.S. share of the import market
- Competitive position of domestic process control instrumentation manufacturers
- Foreign competition in the market

Major Industrial Purchasers

- Discussion of most active market sectors, including potential growth areas of each
- Profiles of typical users of process control instruments
- Expansion plans of major industrial users
- List of items expected to be in high demand by the industrial sectors

Duties and Trade Regulations

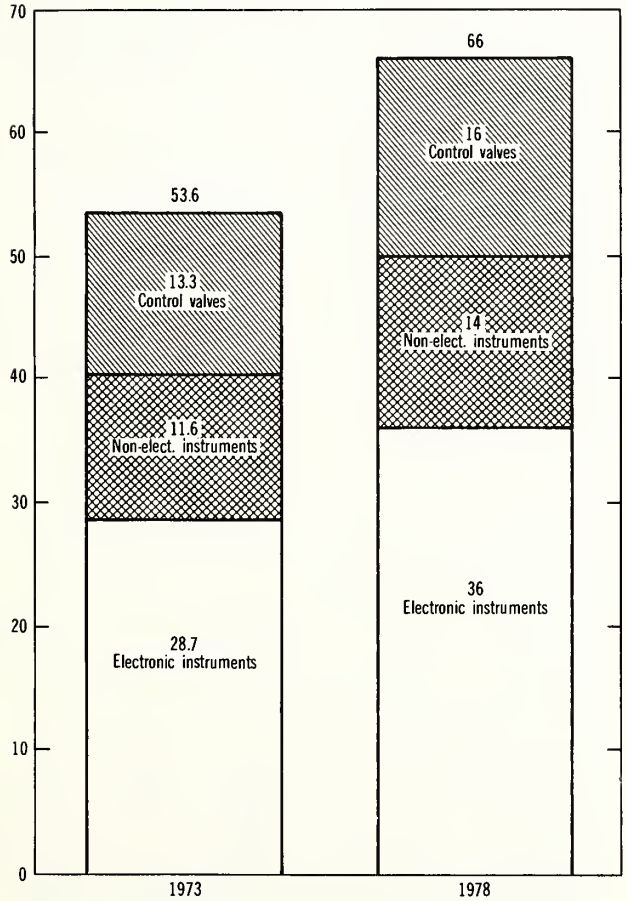
- Mention of duty rates and nontariff trade barriers
- Technical standards and requirements

Australia

Rapid industrial growth, stimulated by new discoveries of vast deposits of minerals, oil, and natural gas, has markedly increased demand for process control instruments and systems in Australia. Consumption of process control equipment rose from $40.5 million in 1970 to $53.6 million in 1973, rising an average of almost 10% per year (see table 1). A number of ongoing projects in the paper and paper products industry and the chemical processing industry should help boost the process control market to almost $59 million in 1974.

Australia: Size of market for process control instruments, 1973 and projected 1978

(in millions of U.S. dollars)



Source: U.S. Department of Commerce, Bureau of International Commerce market research study. Values based on Australian trade source estimates.

The utility services industry has been investing heavily in several projects requiring sophisticated process control instrumentation which are scheduled for completion by 1980. The need for new, large-scale plants to process Australia's mineral wealth should also ensure a continuing demand for process control equipment from the primary metals and other mineral processing industries. Sales of all types of process control instruments are forecast to total $66 million in 1978.

The trend in many Australian industries is toward greater use of *electric/electronic* process control instruments and systems. The market for these devices—$22.2 million in 1970 and $28.7 million in 1973—showed a vigorous average annual rise of 9%. Industrial end-users are expected to spend nearly $36 million for electric/electronic process control instruments in 1978.

Investment in *nonelectric/nonelectronic* process control instruments reached $11.6 million in 1973. Sales in this category are projected to exceed $14 million in 1978.

Consumption of *automatic control valves* advanced rapidly between 1970 and 1973, climbing from $9.2 million to $13.3 million, which represented a high 13% average annual increase. The market for these valves is projected to reach $16 million in 1978.

U.S. major supplier.—Most of the process control instrumentation used in Australia is imported from the United States (see table 2). Process control instruments valued at $46.6 million were imported in 1973, with 48% ($22 million) coming from U.S. manufacturers. Imports increased more than 10% annually between 1970 and 1973 and are expected

Australia—Selected Indicators (1973)

Gross national product:	**$57.5 billion**
Population:	**13.13 million**
Total country imports:	**$7.6 billion**
Total country exports:	**$9.8 billion**
Exchange rate (Nov. 1974):	**Fluctuating at about 0.76 Australian dollars=US$1**

to reach nearly $58 million in 1978. The U.S. share should reach $28 million.

Australia imports virtually all its electric/electronic and nonelectric/nonelectronic process control instruments. In addition, Australia serves as a base for reexport of these instruments to Southeast Asia and New Zealand. Imports of electric/electronic process control instruments are rising somewhat faster than are imports of other types of process control equipment and are forecast to reach $36 million annually by 1978.

U.S. manufacturers consistently supply more than 50% of the electric/electronic process control instruments imported by Australia and provide still more of these products through their Australian licensees and subsidiaries. U.S.-made equipment is highly regarded for its advanced technology and reliability. Australian industry spokesmen specifically mentioned the superiority of American-made electronic flow controllers, on-line chromatographs, and piezoelectric devices. In addition, the United States is considered the leader in sales of process control systems, particularly direct digital control and digital-type supervisory control systems. Considering that the market for these systems is still in its growth stage in Australia, future demand for advanced American-made products seems assured. Industry sources expect in 1978 to import from U.S. firms electric/electronic process control instruments valued at nearly $19 million (about $5 million more than in 1973), representing 53% of the import market.

Australian imports of nonelectric/nonelectronic process control instruments have been growing at an average annual rate of 10%, going from $9.2 million in 1970 to $12.2 million in 1973. These imports are expected to reach $14.5 million in 1978, with 47% supplied by the United States. Australian consumers particularly value American-made pneumatic instruments because of their ability to withstand harsh environments.

Several U.S. firms have subsidiaries manufacturing electric/electronic and nonelectric/nonelectronic process control instruments in Australia: Fischer and Porter Pty. Ltd. produces a wide range of electronic and nonelectronic instruments, including magnetic flowmeters and recorders, and Foxboro Pty. Ltd. assembles and distributes instruments and systems. A number of instruments, including flow sensors, bourdon tubes, transducers, and oxygen analyzers, are produced and imported by Bailey Meters Aust. Pty. Ltd. Products from Leeds and Northrup Australia Pty. Ltd. include direct digital control and supervisory control systems, on-stream analyzers, and temperature recorders. Taylor Instrument Companies of Australia and Honeywell (Aust.) Pty. Ltd. produce, import, and assemble electronic and pneumatic process measuring devices.

Imports supplied roughly 45% of the Australian market for automatic control valves from 1970 to 1973, and this proportion should remain constant through 1978. Valve imports are expected to increase at an average annual rate of nearly 4%, rising from almost $4 million in 1973 to more than $7 million in 1978. Purchases of automatic valves directly from the United States were valued at more than $2 million in 1973; by 1978, U.S. sales are expected to exceed $2.5 million, acounting for 36% of all imported automatic valves.

Foreign suppliers important.—Australian imports of process control instruments from countries other than the United States exceeded $24 million in 1973 and are expected to approach $30 million in 1978. The countries most active in this market are the United Kingdom, Germany, France, Denmark, Italy, Canada, and Japan. Some of their products that

Table 1.—Australia: Size of market for process control instrumentation, 1970, 1972, 1973
(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	2.1	2.5	3.0
Imports	21.6	25.0	28.4
Exports	1.5	1.8	2.7
Market size [1]	22.2	25.7	28.7
Nonelectric/nonelectronic instruments			
Production	.9	1.0	1.2
Imports	9.2	10.2	12.2
Exports	1.0	1.3	1.8
Market size	9.1	9.9	11.6
Automatic control valves			
Production	6.2	7.2	8.6
Imports	3.9	5.1	6.0
Exports	.9	1.1	1.3
Market size	9.2	11.2	13.3
Total process control instrumentation			
Production	9.2	10.7	12.8
Imports	34.7	40.3	46.6
Exports	3.4	4.2	5.8
Market size	40.5	46.8	53.6

[1] Market size equals production plus imports minus exports.
Source: Bureau of International Commerce market research study. Values based on Australian trade source estimates.

have been particularly attractive to Australian consumers include temperature controllers, magnetic flowmeters, spectrophotometers, and thermometers.

Some large European companies in recent years have made significant inroads into the utilities industry, the largest market for process control instruments and systems in Australia. Companies such as Siemens Industries Ltd., of Germany, and Kent Instruments (Australia) Pty. Ltd., of the United Kingdom, have been awarded large contracts in the power generation and transmission sector. Kent Instruments and G. E. C. Ellliott Automation, also of the United Kingdom, were major suppliers to the water supply and sanitary services sectors. These three firms have established subsidiaries in Australia for manufacturing and importing their products. Other major supplier countries to the Australian market include Holland and Japan. Hartmann & Braun, of Germany, has an Australian subsidiary which imports a limited range of measuring and controlling instruments for process management.

The process control instrumentation industry in Australia offers moderate competition in the market. There are approximately 125 domestic firms, and these are dominated by subsidiaries and licensees of U.S. firms. Many manufacturers specialize in only one or two products for a particular end-user industry. Total domestic production of process control equipment reached $12.8 million in 1973 and is expected to expand at an average rate of 3% per year, reaching $15 million in 1978. Local manufacturers supply over 10% of the market for electric/electronic and nonelectric/nonelectronic control instruments, although many firms in Australia assemble these instruments from imported parts. Production of these two categories of instruments reached $4.2 million in 1973 and is expected to rise to only $5 million in 1978. The high investment and research costs necessary for large-scale production of instruments are expected to deter any significant increase in manufacturing in the next 5 years.

Almost two-thirds of the Australian market for automatic control valves is met by local manufacturers, these being encouraged by high tariff protection and licensing agreements with the major U.S. valve producers. Domestic production of valves reached $8.6 million in 1973 and is projected to grow at an average rate of 3% yearly to reach nearly $10 million in 1978. The largest producer of automatic control valves and various regulator valves in Australia is B. C. Richards and Company Pty. Ltd., a Kielley-Mueller licensee. K. J. Bailey Pty. Ltd., a licensee of Rockwell Manufacturing Company, produces mainly butterfly valves and some electronic instruments. The Fisher Control Company has licensed G. E. C. Elliott Automation to produce the wide range of Fisher valves in Australia. The only major Australian-owned manufacturer of process control instruments is Valco Engineering Pty. Ltd., which produces numerous valves, including flow, angle, butterfly, and globe types.

Table 2.—Australia: Imports of selected process control instruments by country of origin, 1970, 1971, and 1972

(in thousands of U.S. dollars)

	1970	1971	1972
Electrical measuring, checking, analyzing, or automatically controlling instruments and apparatus			
United States	7,115	9,211	7,448
United Kingdom	2,018	2,312	2,047
Germany	637	1,797	1,071
France	292	181	694
Other	1,096	1,498	1,601
Total	11,158	14,999	12,861
Pneumatically operated control valves			
United States	567	758	431
United Kingdom	448	485	346
Germany	71	150	195
Canada	66	58	83
Other	58	86	35
Total	1,210	1,537	1,090
Pneumatic devices for the control of temperature, humidity, pressure, vacuum, or rate of flow			
United States	873	1,101	909
United Kingdom	300	393	547
Germany	132	63	106
Italy	—	154	94
Other	185	201	293
Total	1,490	1,912	1,949
Meters, gages, and indicating and recording devices for measuring, checking, or automatically controlling liquids or gases			
United States	758	483	1,189
United Kingdom	197	404	239
Germany	68	228	149
Japan	77	148	305
Other	325	290	245
Total	1,425	1,553	2,127
Thermostats for measuring, controlling, etc., fluids or gases			
United States	443	755	803
United Kingdom	39	72	84
Other	45	64	975
Total	527	891	1,862

Source: Data based on Commonwealth Bureau of Census and Statistics (C.B.C.S.) import figures.

Industry sources indicate that the export market for process control instruments should increase about 3% annually from the 1973 level of $5.8 million, reaching nearly $7 million in 1978. Exports of electric/electronic process control instruments are projected to increase by nearly 7% annually, reaching almost $4 million in 1978. Slower growth (less than 1% annually) in foreign purchases of nonelectric/nonelectronic instruments is expected between 1973 and 1978, reaching $1.8 million in the latter year. Valve exports are forecast to decline slightly from $1.3 million to just over $1 million yearly by 1978.

Major Industrial Users

Research conducted in Australia for the U.S. Department of Commerce, Office of International Marketing, covered 10 major industries that use process control instruments (see table 3). Their total output was estimated at more than $15.5 billion in 1972; combined capital investment exceeded $1.6 billion. These industries had over 500,000 employees working in 8,600 plants in 1972 (see table 4).

Three industries—chemical processing, paper and paper products, and utility services—accounted for 53% of the process control instrumentation market in 1972. Within these industries, four sectors are expected to offer excellent sales opportunities for process control equipment manufacturers over the next 5 years.

Electricity generation and distribution sector.—The utility services industry acounted for 27% of the Australian process control instruments market in 1972 and should remain one of the largest users of these devices throughout the 1970's. Although the electricity and natural gas sectors will offer outstanding opportunities to process control instrument producers in the near future, there should also be a sizable demand for these products from the water supply and sanitary services and the irrigation systems sectors.

The electricity generation and distribution sector is considered by industry spokesmen to be the largest consumer of process control instruments in Australia. Responsibility for providing electric power rests largely with federal, state, and local government authorities. Although each state has developed its own distribution pattern, most of the electricity is generated by large state-controlled bodies and sold to smaller local councils and distributors. There were 167 establishments, employing 60,195 persons, in the electricity generation and distribution sector in 1970. Sales amounted to $1.3 billion, with capital investment reaching $428 million.

The installed generating capacity of the country's main electrical supply systems totaled 13,454 megawatts (MW) in 1971. This total represented a 137% increase over the 6,314-MW capacity available in 1961. Approximately 70% of the generating systems use thermal power, 27% are hydro powered, and the remaining 3% are supplied by internal combustion engines.

The rising demand for electric power, plus a trend toward consolidation of scattered generating plants, has led to continuous building since 1971 in the electricity generation and distribution sector. As of June 30, 1972, there were 25 projects under construction, at an estimated cost of $2 billion.

New South Wales and Victoria, the most industrialized states, lead in electricity generation and reticulation. The Electricity Commission of New South Wales has undertaken a large number of projects during the last 4 years to boost the State's generating capacity. Current plans include the building of two 500-MW units at Wallerawang in 1976 and 1980, and the construction of four 700-MW units at Point Eraring in the early 1980's at an estimated cost of $500 million, with $12 to $20

Table 3.—Australia: Size of industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Sales 1972	Capital investment 1972	Process control instrumentation consumption 1972	1978
Natural gas liquids	n.a.	n.a.	.94	1.97
Food processing	6,301	214.1	3.28	5.26
Paper and paper products	808	58.3	4.68	8.55
Chemical processing	1,823	103.8	7.03	10.53
Petroleum	373	21.6	4.68	5.26
Stone, clay, and glass	1,192	69.9	2.81	5.26
Primary metals and other mineral processing	3,164	528.7	10.77	13.16
Pipelines service	n.a.	n.a.	—	.66
Utility services	1,952 [1]	607.9 [2]	12.65	15.13

[1] 1970 data.
[2] 1971 figures.
Source: Bureau of International Commerce market research study.

million budgeted for process control instruments and systems.

The State Electricity Commission of Victoria, which provides nearly all of that State's electricity, spent $102 million on capital improvements in 1972. The Commission intends to increase its generating capacity from 4,171 MW in 1974 to 6,376 MW in 1980 by building several major new plants.

The Newport Power Station, due for completion in 1978, will comprise two generating units, both having 500-MW capacity, fueled primarily by natural gas. The plant is expected to cost some $210 million.

The proposed power station at Yallourn, Victoria, will comprise four turbogenerators of 350 MW each and four matching pulverized brown coal boilers, each with 315 kilograms per second capacity. The first unit began operating in 1973 and the second was due in late 1974. The third and fourth units have been programed for completion in 1979 and 1980, respectively.

A hydroelectric station is projected for Dartmouth, Victoria. This plant, with a generating capacity of 150 MW, is expected to open in 1979. Plans have recently been announced by Loy Yang for the completion by 1982 of a new power station comprising four 500-MW units using brown coal.

The State Electricity Commission of Queensland regulates and controls the electrical supply throughout that State, delegating the responsibility for generation, transmission, and distribution of electricity to regional authorities. Queensland plans to consolidate its many smaller authorities by constructing large generating plants such as the proposed four-unit (275 MW capacity each) station at Gladstone, costing $231 million; the first unit should be operating by 1976. The State's substantial coal reserves supplied 90% of the fuel for generating its electricity in 1971.

Electricity is generated in South Australia by government organizations, local authorities, private firms, and industrial end-users. Output from all sources in 1972 totaled 4,650 million kilowatt-hours (kWh), half of it produced by gas-fueled equipment. The Electricity Trust of South Australia, the state generation authority, began construction on the Torrens Island "B" Power Station in 1970. This complex will be the largest electricity-generating plant in South Australia when it is completed in 1976. The two 200-MW units should cost an estimated $75 milion.

The rapid economic growth of Western Australia (averaging 15% annually during the 1969-73 period) necessitated the creation of several new projects to increase electricity-generating capacity in the early 1970s. Most of these programs were associated with mining ventures in newly exploited mineral deposits. The State Electricity Commission of Western Australia, which is empowered to coordinate all such undertakings, expects expenditures for generating plants and associated facilities within the state to continue rising through 1978. The Commission claimed that capital investment by the State in the electricity generation and distribution sector totaled almost $40 million in 1972. Future developments include the addition of two 200-MW units to the Kwinana power station by 1976 at an estimated cost of $65 million.

Table 4.—Australia: Industries using process control instruments, by number of employees and establishments, 1972

Industry	No. of establishments	No. of employees
Natural gas liquids	12	n.a.
Food processing	4,423	201,425
Paper and paper products	337	30,816
Chemical processing	1,105	60,187
Petroleum (refinery sector)	17	4,173
Stone, clay, and glass	1,854	51,202
Primary metals and mineral processing	628	92,760
Utility services (1970)[1]	222	69,845

[1] Gas and electricity sectors only.
Source: Bureau of International Commerce market research study.

The electricity generation and distribution sector in Australia promises a large and expanding market for process control instruments for years to come. The following is a partial list of items having good sales potential over the next 5 years:

- On-stream analyzers
- Data loggers
- Direct digital control systems
- Automatic control valves
- Flow, temperature, and pressure regulators

The Liddell Power Station, the largest on the continent, uses perhaps the most sophisticated process control system in Australia. Built by the New South Wales Electricity Commission in 1973 at a cost of $376 milion, this plant burns up to 6 million tons of coal per year in its four 500-MW turbogenerators, and an additional 12-MW gas turbine unit provides backup power. Most control duties are carried out by more than 40 automatic analog control loops, and direct digital control is also used in the turbine startup operation. The functions monitored by the digital computer system for each of the 4 units are as follows:

- Electrical loads and voltages (65 analog inputs)
- Turbine supervisory (41)
- Bearing temperatures and lubricating systems (129)
- Winding, air and oil temperatures of auxiliary motors, regulators, and transformers (90)
- Chemical analysis (25)
- Generator temperators (86)
- Steam and water temperature (134)
- Tube and pipe metal temperature (185)

- Boiler, gas and air temperature (38)
- Miscellaneous pressures (60)
- Miscellaneous flows (30)
- Level and position measurements (17)

The total value of process control instruments and systems (excluding computers) installed in the Liddell Power Station is estimated at $10 to $12 million. Particular types of instruments in use include oxygen on-stream analyzers, pressure transmitters, temperature and pressure controllers, data loggers, annunciators, numerous valves, and other electric/electronic instruments.

Natural gas production and distribution sector.— Natural gas is relatively new to Australia, where it was first discovered in commercial quantities in 1960. Manufactured gas had long been an important source of energy, supplied through state agencies to many towns and cities. The introduction of natural gas, with its low basic cost, attracted many new customers, including large industrial consumers. This increased demand led to extensive conversion programs, plus major pipeline projects to transport the natural gas to population and industrial centers. Substantial additional expenditure is planned for the next 5 to 10 years, providing an excellent market for process control instruments.

The Australian natural gas production and distribution sector consisted in 1970 of 55 establishments, employing 9,650 people. Sales in that year reached $144.1 million, with capital investment totaling $34 million. Natural gas production reached 9,374 million cubic feet (ft^3) in 1970 and rose to 113,876 million ft^3 in 1973. U.S. subsidiaries involved with natural gas production in Australia, particularly Esso Standard Oil (Aust.) Ltd. and Delhi (Aust.) Petroleum Ltd., acounted for approximately 25 to 35% of sales, while other foreign firms accounted for 20 to 25%.

The first utility company to supply natural gas to its consumers was Queensland's South Brisbane Gas Company (now known as Allgas Energy Ltd.), which changed its system from manufactured gas in March 1969. Natural gas is produced in Queensland by the Associated Group, which has a current output of 24 million standard cubic feet ($stdft^3$) a day. Sales of natural gas reached 9,491 million ft^3 in 1973, and this was distributed principally by Allgas Energy Limited, Brisbane Gas Co. Ltd., and Gas Supply Franchises Pty. Ltd.

Esso Standard Oil (Australia) Ltd., a subsidiary of Exxon, U.S.A., and the Broken Hill Proprietors Company Ltd. (B.H.P.), an Australian firm, produce natural gas in Victoria. The Gas and Fuel Corporation of Victoria, a State Government instrumentality, is the major gas distributor in Victoria and controls all natural gas transmission mains. The Corporation began converting to natural gas in April 1969. Gas consumption in the state by 1973 reached 51,974 million ft^3 a year, nearly 40% of Australia's total consumption. Contracts have already been signed to supply large quantities of gas to cement works and paper mills, and an agreement has been reached to supply the new 1,000-MW power station at Newport. To cater to Newport's large requirements and growing consumer demand, a new cryogenic gas plant with a capacity of 300 million $stdft^3$ is planned for construction during the 1974-76 period. The plant is expected to cost approximately $35 million, and plans include approximately 85 control loops with analog supervisory control.

The South Australian Gas Company distributes gas produced in the State by Santos Ltd., and Delhi Petroleum Ltd. The market for pollution-free energy in the form of natural gas has grown rapidly among South Australian industries, with the greatest demand coming from the ceramic industry (for its tunnel kilns), the automotive industry and the electricity generation sector. Adelaide received approximately 61 million ft^3 of natural gas a day in 1973, while the entire state used nearly 40 billion $stdft^3$ of natural gas that year.

Western Australia consumed 15 billion $stdft^3$ of natural gas in 1973. A consortium known as the West Australian Petroleum Pty. Ltd. (WAPET) produces natural gas from deposits within the state. The West Australian Natural Gas Pty. Ltd. buys and distributes the gas. The pipeline transporting natural gas from the Western Australian fields will eventually include 6 compressor stations. Two stations are already installed and construction is proceeding on two others. The compressors are 2-stage centrifugal Solar units driven by 820-kilowatt (kW) Solar gas turbines. A continuously manned central control room in Perth monitors and controls all relevant conditions of the transmission main through a comprehensive telecommunications system.

The largest concentration of population and industry in Australia is centered around Sydney, but no commercial discoveries of natural gas have been made in New South Wales. The Sydney Gas Distribution, headed by the Australian Gas Light Company, has arranged for the Santos/Delhi group to supply Sydney with natural gas from Moomba in South Australia. To meet this increased demand for gas, the Santos/Delhi group is building a new processing plant at Moomba with a capacity of 303 million $stdft^3$ of processed natural gas per day.

The Sydney-Moomba pipeline must cover some 850 miles and is expected to cost about $300 million, with $2 to $3 million allocated for process control instrumentation. A direct digital control system using 34 closed process loops will be installed in Sydney. At Young, in central New South Wales (about 240 miles from Sydney), a digital supervisory control system will be implemented.

Communications systems based on microwave tele-

communication facilities will be installed in the pipeline. Block valves with automatic controls will be used to take care of pipeline breaks, and remotely controlled transmitters will measure pressure in the pipeline every 40 miles. Process control instruments needed for this project include density, oxygen, and carbon analyzers; ball valves; electronic mass flowmeters; pressure and temperature transmitters; and turbine meters. Five compressor stations using minicomputers are to be built along the pipeline in the next 10 years.

The Australian Government in February 1973 announced plans to build an immense nationwide gas pipeline linking the country's major natural gas fields with all the state capitals and important inland industrial centers. This venture would provide a completely interconnected grid system costing approximately $1.2 billion. Plans for the massive project are not yet finalized, but construction might begin as early as 1978.

The natural gas production and distribution sector should provide an excellent market for process control instruments for many years. Particularly strong demand is expected for the following items:

- Pressure transmitters
- Block valves
- Ball valves
- Direct digital control systems
- Density analyzers
- Electronic mass flowmeters
- Temperature transmitters
- Turbine meters
- Moisture analyzers
- Analyzers for hydrogen, sulfide, nitrogen, oxygen, and carbon

Industrial inorganic chemicals sector.—The Chemical Processing Industry has been one of the major consumers of process control instruments in Australia, accounting for 15% of total purchases in 1972. Changes in the investment climate reduced expansion during the late 1960's, but the rising worldwide demand for chemicals has altered this trend and future growth now seems assured. In view of present plans for construction of several new chemical processing plants, the level of capital investment is expected to increase substantially in 1974 and the years to follow.

The industrial inorganic chemicals sector in Australia will probably continue to provide an excellent market for process control instruments in the future. This sector utilizes the latest technological advances and highly sophisticated equipment. Approximately 84 establishments, employing some 7,000 people, were involved in inorganic chemical production in 1972. Sales turnover in this sector reached $168 million in 1972, with 55 to 65% of total output supplied by the 5 leading firms. Imperial Chemical Industries of Australia and New Zealand (I.C.I), a United Kingdom subsidiary and the leading domestic producer, accounted for 25 to 30% of total sales. Two U.S. subsidiaries, Dow Chemical Company (Aust.) and Monsanto Australia, provided 20 to 30% of sales, and two Australian firms, C.S.R. Chemicals, and Ajax Chemical Ltd., supplied 5 to 10%. All national manufacturers account for 30% of domestic production, U.S. subsidiaries provide approximately 35%, and third-country subsidiaries supply the remaining 35%.

The major products of this sector are sulfuric, nitric, phosphoric, hydrochloric, and acetic acids. The two most significant alkalis produced are sodium hydroxide (caustic soda) and sodium carbonate. The demand for caustic soda has risen sharply with the recent growth of Australian aluminum production.

Capital investment in the industrial inorganic chemicals sector reached $28 to $32 million in 1972 and grew to an estimated $45 to $50 million in 1974. These expenditures are forecast to rise substantially during the next 5 years.

The world shortage of industrial inorganic chemicals is leading Australian producers to consider entering the international market on a much larger scale. Many chemical firms are expanding and an extensive new chemical plant is planned for Redcliff Point, South Australia. The Redcliff plant will be built at a cost of $450 million by a consortium composed of I.C.I., Alcoa (Aust.), Mitisubishi, Ampol, and C.S.R. The builders hope to have the plant operating by 1978 or 1979, with production capacity of 420,000 tons of caustic soda a year. The plant may also process natural gas and liquid gas from the Cooper Basin into automotive fuel. Industry sources suggest that the value of process control instruments and systems required for this enterprise could easily reach $10 million. The requirements will include numerous types of valves, on-stream analyzers (of chlorine and hydrogen content of gas), and predominantly electric/electronic process control instruments.

Dow Chemical (Aust.) is also considering building a petrochemical complex in Australia. This project is still in the planning stage and no further details are available.

The industrial inorganic chemical sector should provide an excellent market for process control instruments and systems through 1978. The trend is toward greater use of digital systems, although both analog and digital systems should present good sales opportunities. Nonelectric/nonelectronic instruments are sought by firms that produce corrosive products. Demand is expected to be highest for the following products:

- On-stream analyzers
- Electronic pressure and temperature indicators
- Butterfly- or globe-type valves

- Pneumatic flow, level, and temperature controllers
- Multiple-point temperature recorders
- Thermostats
- Magnetic flowmeters
- Variable area flowmeters
- Indicating controllers
- PH controllers

A large process control system is operating in the Nabalco Alumina plant at Gove. This bauxite treatment plant, completed in 1973 at a cost of $450 million, has a current production capacity of 1 million tons of aluminum per year, with provision for expansion to 2 million tons. The refinery uses the Bayer process, controlled by a complex electronic logic system using 1,200 electronic loops, which in turn controls 1,000 valves and 600 motors. About 60% of the plant is operated from control consoles in a central control room and the remainder from a few local control panels. A unique feature of the plant is the solid-state interlocking system that allows remote control of plant electrical motors. An indication of the types (and numbers) of instruments used is given in the folowing partial list:

- Magnetic flowmeters, 2 inches through 16 inches (85)
- Controllers (345)
- Recorders (150)
- Large case field-mounted transmitters and controllers (250)
- Force balance transmitters (40)
- Differential pressure transmitters (200)
- Conductivity transmitters (22)
- Linear feet of instrument, power, termination, communication, and logic panels (850)
- Logic cubicles (84)
- Solid state logic cards (2,500)

Pulp, paper, and paperboard mills sector.—The paper and paper products industry accounted for 10% of the process control instruments purchased in Australia in 1972. Investment in these products is expected to grow nearly 11% annually, reaching $8.6 million in 1978. The greatest demand for process control items is expected to come from the pulp, paper, and paperboard mills sector, which produced nearly 40% ($320 million) of industry output in 1972.

The pulp, paper, and paperboard mills sector in Australia is vertically integrated, with only six companies. In 1972, the sector comprised 21 plants employing 11,221 people. Output of paper (including newsprint) and paperboard reached 1,072,000 tons in 1971, representing about 62% of local demand. The largest company, Australian Paper Manufacturers Ltd. (A.P.M.), produced over 55% of total output in 1972, while the three largest companies, A.P.M., Australian Newsprint Mills Ltd., and Associated Pulp and Paper Mills Ltd. (A.P.P.M.) accounted for almost 90%. Ownership and control of the sector are largely Australian. Two of the six firms are wholly Australian, with Australian concerns predominant in two others. Kimberly-Clark, for example, is owned 50% by A.P.M. and 50% by U.S. interests.

The worldwide growth in demand for paper and paper products has led to sizable expansion in the Australian paper industry. Capital expenditure for this sector reached $28 million in 1972 and was estimated at $32 to $40 million in 1974. A.P.M. has announced plans for a $120- to $150-million enlargement of its Maryvale plant in Victoria during the 1974-79 period. The current plant capacity of 200,000 tons per year will be increased to 350,000 tons. A.P.M. also expects to spend $30 to $40 million to expand the existing plants at Botany, Fairfield, and Petrie in late 1974 to 1975. Fairfield's mill capacity will be enlarged from 80,000 to 95,000 tons and the Petrie output will be boosted from 66,000 to 80,000 tons per annum. A $20 million chemical recovery plant is currently being built at Maryvale. A.P.P.M., as well, plans to enlarge its Tasmanian facilities at a cost of $150 million, with a significant portion of the expansion going for pulp, paper, and paperboard production. Plant construction is tentatively set to begin in 1978.

Australian paper producers are becoming highly sophisticated in production processes. The trend is toward digital instruments and systems, although many of the analog-type sensing elements are likely to remain in use. There is a need for rugged instruments that can withstand shock and adverse environment. Products with good sales potential over the next 5 years include:

- Direct digital control systems
- On-stream analyzers
- Magnetic flowmeters
- Control ball valves
- Stainless steel butterfly valves
- Instruments for wet end refining
- Machine speed and drainage control
- Moisture meters
- Pressure and level meters
- Infrared meters
- Electronic pH meters
- Chromatographs

The Fairfield Paper plant at Melbourne, Victoria, one of the largest of eight plants owned by the A.P.M. group, can produce 95,000 tons of paper annually. Its large process control system uses electronic instruments, primarily. Direct digital control is used to provide efflux ratio control, basis weight control, refining control (to balance quality and maximum production), and speed and moisture control. The computer system monitors 100 analog inputs, 84 digital inputs, and 36 digital outputs. Analog inputs come from the process measurement sensors and set points; digital inputs come from thumbwheel data switches, limit switches, motor starters, and pushbuttons. The computer digital out-

puts are relays which operate motorized setpoints, lamps, and motor contractors. Conventional panels, electronic controllers, and recorders are used in the 120 loops in the machine area. Process measures include flow, pressure, temperature, power, and consistency.

Other sectors offering good sales opportunities.—Several other sectors in Australia are expected to provide good markets for process control instrument manufacturers during the 1974-78 period. Companies in the Australian food processing industry show a growing preference for automatic control systems for their drying, handling, and pasteurizing processes. This industry has grown quite large, along with the development of a substantial export market. Sales topped $6 billion in 1972 and investment in process control instruments exceeded $3 million. Consumption of process control devices in this industry is projected to rise more than 8% annually from 1972 through 1978. The sugar and confectionery manufacturing sector is expected to have especially high requirements for process control instruments over the next 5 years.

The stone, clay, and glass industry represents a growth market for process control instrument producers. Annual investment in this equipment is expected to double between 1972 and 1978 as a result of increased production in the flat glass manufacturing sector and the growing use of sophisticated process control instruments in the hydraulic cement mills sector.

The petroleum industry used 10% of the process control instruments purchased by Australians in 1972. The petroleum refinery sector is expected to continue making significant investments in this equipment through 1978. However, future investment planning has been deferred until the results of a Royal Commission's study of the Australian petroleum industry are made known.

The primary metals and mineral processing industry together accounted for 23% of all the process control instruments purchased in Australia in 1972. New discoveries of large mineral deposits—particularly iron ore, coal, mineral sands, nickel, uranium, and bauxite—ensure the continuing growth of this industry. Most mineral processing ventures are export-oriented, requiring large-scale operations, and many projects such as iron ore pelletizing plants, treatment plants, and bauxite plants need sophisticated process control instruments and systems. The highest demand for process control equipment in this industry over the next 5 years is expected to come from the blast furnaces and basic steel mills sector, the iron and steel foundries sector, and the primary nonferrous metals mills sector.

Duties and Trade Regulations

Duty rates for process control instruments entering Australia vary from 5.6 to 31.9%, with marginally lower rates on goods imported from certain members of the British Commonwealth. Importers actually pay very little duty on electric/electronic process control instruments. Most producers apply for "Ministerial Determinations" which alleviate payable duty if a company can prove that the local industry does not object to importation of the product. Within the tariff system, goods may also enter duty-free under "by-law" if it can be shown that the imported product is not manufactured locally.

Information on specific duty rates may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 4016, Main Commerce Building, Washington, D.C. 20230.

Electricity in Australia is generally supplied at 240 volts alternating current, and 50 cycles. The normal safety standards detailed by the International Electric and Technical Association are required with electronic equipment. Further information on technical standards is available from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

The following market research survey is available on loan from the U.S. Department of Commerce, Domestic and International Business Administration, Room 1617-M, Main Commerce Building, Washington, D.C. 20230:

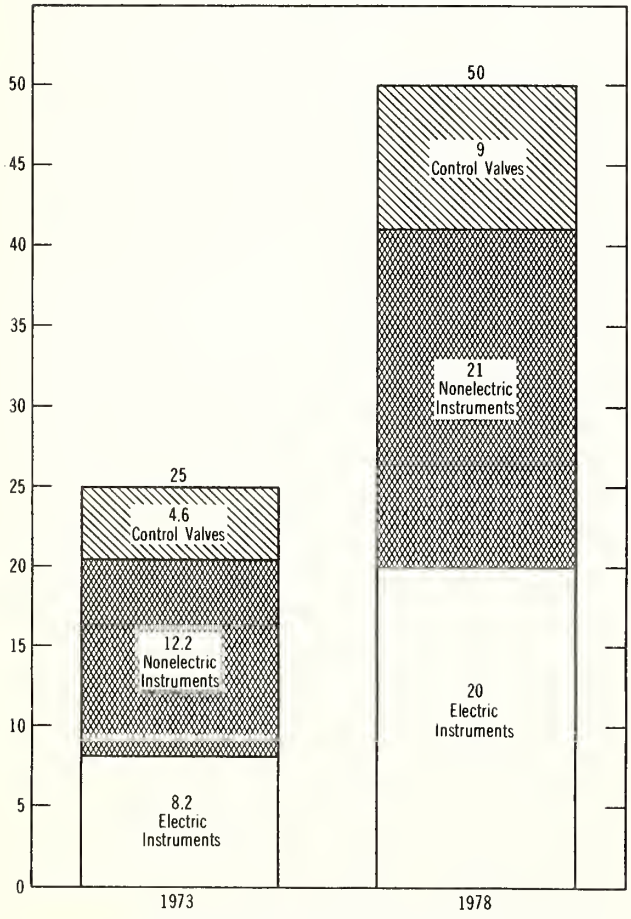
"The Australian Market for Process Control Instrumentation," DIB 74-08-500, March 1974.

Brazil

Rapid growth predicted for Brazil's major processing industries should ensure a high rate of expansion in the control instrument market there for the next several years. Purchases are expected to reach $50 million in 1978, representing a 15% average annual rise over the 1973 level of $25 million (see table 1). Extending the country's oil refining capabilities and building a solidly based petrochemical complex are cornerstones of the Government's economic policy. In 1973 alone, 11 new projects were approved in the petrochemical sector; these endeavors required an investment of $233 million. Furthermore, approximately $1.7 billion is tabbed for expansion of the Brazilian steel industry between 1971 and 1976, and the country's goals are to more than triple steel production by 1980.

Brazil: Market size of process control instrumentation, 1973 and projected 1978

(in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Brazilian trade source estimates.

Analysis of the Brazilian process control instrument market reveals a steady trend toward more widespread use of *electric/electronic instrumentation.* Purchases of this type of equipment are accelerating as industrialists cope with the increasing geographical diversity of their operations and the desire to use new methods for new projects. The market for electric/electronic instruments in 1978 should reach $20 million, or some two-and-one-half times the $8.2-million figure recorded in 1973. By comparison, purchases of *nonelectric/nonelectronic* instruments were valued at $12.2 million in 1973 and are expected to reach the $21-million mark in 1978. Brazil's market for *automatic control valves* is predicted to nearly double during the 1973-78 period, climbing from $4.6 million to $9 million.

Market dominated by imports.—Brazil traditionally has relied on imports to meet nearly all its needs for process control instruments. Sales by foreign suppliers rose from $15.6 million in 1970 to $24 million in 1973, when they accounted for 96% of the total market. Brazilian purchases of control equipment from abroad are expected to increase by some 14.4% annually between 1973 and 1978, expanding from an estimated $24 million to $47 million.

The United States has an unsurpassed reputation in Brazil for high-quality process control instruments and is by far the country's leading supplier. Imports of American-made instrumentation were valued at

Brazil—Selected Indicators (1973)

Gross national product:	**$63.5 billion**
Population:	**103 million**
Total Country imports:	**$6.0 billion**
Total country exports:	**$6.2 billion**
Exchange rate (April 1974):	**Fluctuating at about 8.7 cruzeiros=US$1**

$9.7 million in 1972, accounting for 48% of the import market (see table 2). United States sales are expected to double by 1978, approaching $19 million in that year. Between 1973 and 1978, growth of electronic instrument imports from the United States should average 16.4% annually and reach a level of $7.7 million in the latter year. At the same time, sales of nonelectric controls are expected to rise at a slower rate, 8.5% per year, topping $8.2 million in 1978. U.S. manufacturers are forecast to supply automatic control valves valued at almost $3 million in 1978.

Foxboro is among the U.S. suppliers who have successfully penetrated the Brazilian market with its electronic and pneumatic lines of control instrumentation. Honeywell's "Vutronik" equipment holds a favorable position, particularly in the steel industry. Honeywell also ships to Brazil from its Japanese subsidiary, Yamatake-Honeywell. Fischer and Porter supply the utilities and paper products industries. The petroleum industry is purchasing controls from Taylor Instruments' subsidiary in France. Other countries tend to participate in the Brazilian process control instrument market on a more limited basis, and their market shares fluctuate. In 1972, Germany provided control instruments valued at $3.6 million, up from $2 million in 1970. Great Britain and Japan have also achieved some market penetration, with 1972 sales of $1.6 million and $1.2 million, respectively.

Domestic manufacture of process control instruments in Brazil is in the embryonic stage. It is mainly limited to assembly operations using imported parts and to the fabrication of control panels and consoles. There is some production of conventional valves, manometers, pyrometers, and converters. In all, Brazilian output was estimated at $1.7 million in 1974 and is not expected to exceed $5 million in 1978.

The major process control instrument manufacturers are Hartmann & Braun Controles Electricos S.A., a German subsidiary, and Instrumentos Eletricos Engro S.A., each of which fabricates panel instruments. Other sizable firms producing process control instrumentation include Instrumentos Bristol do Brasil S.A. and Taylor Instrumentos do Brasil Ltda., both subsidiaries of U.S. companies. Bristol assembles pneumatic and mechanical process control instruments and parts, and Taylor makes pneumatic panel instruments. Masoneilan Valvulas e Equipamentos Ltda. and Engematic-Engenharia, Automatisacao, Industrial Limitada are small companies specializing in the manufacture of valves. All these firms except Engro and Engematic are subsidiaries of international concerns and rely heavily on imports from their parent companies.

Although the long-range growth prospects for Brazil's process control instrument industry are good, little expansion is expected before 1978. Local manufacturers consider the market too small to justify major investments at the present time.

Major Industrial Users

Research conducted in Brazil for the U.S. Department of Commerce, Office of International Marketing, surveyed eight major industries that comprise virtually the entire local market for process control instrumentation. Their combined sales were estimated at nearly $25 billion in 1973 and their total capital investment exceeded $13 billion in the previous year (see table 3). Out of the 812 end-user enterprises, some 35% are medium-to-large companies with net assets over $5 million (see table 4). Thirty companies have net assets in excess of $100

Table 1.—Brazil: Size of market for process control instrumentation, 1970, 1972, 1973

(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	—	.1	.2
Imports	5.3	6.9	8.0
Exports	—	—	—
Market size [1]	5.3	7.0	8.2
Nonelectric/nonelectronic instruments			
Production	.2	.4	.4
Imports	7.6	10.0	11.9
Exports	—	—	.1
Market size	7.8	10.4	12.2
Automatic control and regulator valves			
Production	.3	.6	.7
Imports	2.7	3.4	4.1
Exports	—	.1	.2
Market size	3.0	3.9	5.6
Total process control instrumentation			
Production	.5	1.1	1.3
Imports	15.6	20.3	24.0
Exports	—	.1	.3
Market size	16.1	21.5	25.0

[1] Market size equals production plus imports minus exports.

Source: Bureau of International Commerce, Office of International Marketing research study.

million, and at the other end of the spectrum are 527 small firms with net assets between $1 million and $5 million.

The chemical processing, petroleum, and primary metals industries accounted for 61% of the country's overall consumption of process control instruments in 1972; projections for 1978 show purchases of $34 million, or nearly 70% of total consumption. These end-users are entering rapid growth periods, characterized by heavy investment in capital equipment and plant facilities.

Petrochemical sector.—Petrochemical production began in Brazil in 1972 when the Petroquimica Uniao complex was opened. There are now approximately 136 Brazilian enterprises engaged in the manufacture of petrochemical products, including 25 companies with net assets above $10 million.

The sector's 1976 annual output, which should reach almost 1.6 million metric tons (MT), will consist of the following: 276,100 MT of ammonia; 250,100 MT of propane; 485,100 MT of ethylene; 180,775 MT of benzene; 124,000 MT of calcium carbonate; and 264,582 MT of other petrochemicals. The industry's installed capacity in 1971 was over 800,000 MT per year.

The Brazilian Government is a major presence in the petrochemical industry through Petrobras Quimica S.A. (PETROQUISA), a subsidiary of Petroleo Brazilerio Petrobras S.A., the state-owned petroleum company. Despite the sizable interests of the Government in the petrochemical sector, foreign concerns account for 51.2% of the industry's total investment. Sales figures also reflect the significant role of foreign enterprises. Out of total sales of $440 million reported by the 11 largest companies in 1972, about 26.6% were made by national industries, 10% by U.S.-controlled companies, and 63.4% by other foreign-controlled firms. Major foreign companies in the petrochemical sector include Union Carbide do Brasil Alba S.A., a U.S. subsidiary, Rhodia Ind. Quimicas e Texteis S.A., a French concern, and the Dutch-owned Industrias Quimicas Eletro Cloro S.A.

Investment in the Brazilian petrochemical sector—$653 million in 1972—is expected to exceed $1 billion in 1975 and $1.7 billion in 1980. One of the largest new projects, the Petroquimica do Nordeste, already is under construction. The complex is being built around some existing plants known as Conjunto Petroquimica da Bahia, producing ammonia and urea. The Petroquimica complex eventually will consist of 20 production units, requiring a total initial investment of $307 million. The first stage of construction will include 14 plants as well as a utilities center and a maintenance center. Both centers are scheduled for completion in 1975; production in the 14 plants is slated to begin in 1976. An estimated 12,000 closed loops will be required to control production in the complex.

Table 2.—Brazil: Imports of process control instrumentation by country of origin, 1970, 1972
(in millions of U.S. dollars)

	1970	1972
Electric/electronic instruments		
United States	2.4	3.2
Germany	.8	1.4
Great Britain	.3	.4
Japan	.2	.4
Other	1.6	1.5
Total	5.3	6.9
Nonelectric/nonelectronic instruments		
United States	4.6	4.9
Germany	1.0	1.8
Great Britain	.9	.9
Japan	.2	.5
Other	.9	1.9
Total	7.6	10.0
Automatic control valves		
United States	1.8	1.6
Germany	.2	.4
Great Britain	.3	.3
Japan	.1	.3
Other	.3	.8
Total	2.7	3.4
Total process control instrumentation		
United States	8.8	9.7
Germany	2.0	3.6
Great Britain	1.5	1.6
Japan	.5	1.2
Other	2.8	4.2
Total	15.6	20.3

Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Brazilian trade statistics.

A marked shift to electronic and computer-controlled instrumentation is expected to gain momentum through 1980. The underlying reason for this trend is the increasing size and dispersion of production units requiring the use of centralized control rooms.

Typical of the medium-size companies in the sector is Cia. Petroquimica Brasileira (COPEB RAS) in Cubatao. The company's sulfuric acid plant utilizes some 25 closed loops. It has 20 control valves of Fischer & Porter and Masoneilan manufacture; 21 Foxboro control panel pneumatic instruments; 10 pneumatic transmitters (Taylor); 32 thermocouples; and about 40 indicators. Petroquimica's monoammonium phosphate plant has 12 closed loops, with 11 control valves made by Masoneilan, Fischer & Porter, and Hiter, and 11 panel-mounted pneumatic instruments by Foxboro. In ad-

Table 3.—Brazil: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Sales 1973	Capital Investment 1972	Process control instrumentation consumption 1972	1978
Food processing	5,827	1,576	1.7	4.0
Paper and paper products	782	455	2.8	3.5
Chemical processing	3,545	1,001	4.3	11.0
Petroleum [1]	8,542	2,315	5.1	12.5
Stone, clay, and glass (including nonmetallic minerals)	1,227	650	2.3	6.0
Primary metals	1,254	558	3.6	10.5
Utility services	n.a.	6,703	1.5	2.5

[1] Includes natural gas liquids industry.
Source: Bureau of International Commerce, Office of International Market research study.

dition, it is equipped with a panel-mounted temperature control instrument by Leeds & Northrup; 5 Taylor transmitters; a Foxboro magnetic flowmeter; and 10 indicators of domestic manufacture. The firm's plant for the manufacture of diammonium phosphate and granulated fertilizers incorporates 15 control loops; 9 control valves by Masoneilan and Hiter; 16 Foxboro control panel pneumatic instruments; and 9 Taylor pneumatic transmitters. The sodium tripolyphosphate plant has 40 closed loops. Its instrument content is approximately equal to the total of the three other plants.

Expansion of the COPEBRAS operations should bring its capacity to the following levels by 1975: 80,000 MT per year of carbon black; 300,000 MT of sulfur superphosphate; 330,000 MT of sulfuric acid; and 100,000 MT of phosphoric acid. Capacity at its granulated plant is scheduled to reach 130,000 MT per year of monoammonium phosphate, 60,000 MT of sodium tripolyphosphate, and 40,000 MT of diammonium phosphate.

Petroleum refinery sector.—Brazil's 11 refineries realized $6 billion in sales during 1973. All but four of the refineries in operation are owned by Petroleo Brazilerio Petrobras S.A., a state concern which has a near-monopoly on petroleum. Brazilian petroleum production was nearly 63 million barrels (bbl) in 1972. Imports in that year amounted to approximately 139 million bbl, and the apparent throughput was 202 million bbl.

The Petrobras complex in 1972 had net assets of more than $1.7 and an installed capacity of 742,000 barrels per day (bpd). In addition Petrobras operates its own fleet of tankers, including 32 vessels with a capacity equivalent to 931,000 MT deadweight. Fifteen more tankers are on order and four combined tanker/ore ships are being made in Brazilian shipyards. Petrobras also operates six port terminals and some 1,260 kilometers (km) of pipeline.

Steady expansion is planned for the Brazilian petroleum industry. The enlargement of the Sao Paulo refinery will enable it to handle 26,000 bpd. Construction of a new refinery with a capacity of 125,000 bpd is scheduled to begin at Araucaria (Parana) in 1976. Enlargement of the refinery at Mataripe, Bahia, to a capacity of 138,000 bpd is scheduled, as also is construction of another refinery for 1977-78 at Sao Jose dos Campos, in Sao Paulo, with a capacity of 189,000 bpd.

Increases in petroleum production will necessitate heavy investments in process control instrumentation; the industry's consumption is expected to climb from $5.1 million in 1972 to $12.5 million in 1978. Electronic and computer-controlled instrumentation systems will be most in demand. Brazilian oil refining operations are becoming more widely dispersed geographically and will need to be centrally controlled. The trend toward more sophisticated end-products, blends of gasoline and lubricants, also will require the use of increasingly advanced instruments. Expansion plans will require some 2,000 closed loops during the 1974-78 period.

The Petrobras plant at Paulinia in Sao Paulo, the complex's third largest refinery, has 200 process control loops that use Taylor instrumentation. The same number of closed loops are used at the Petrobras refinery at Mataripe. The latter utilizes analog pneumatic instruments by Foxboro, and the Sao Paulo refinery has analog electronic controls. Brazil's third and fourth largest refineries—Refineracao de Petroleo Manguinhos S.A. in Rio de Janeiro and Ipiranga Refineria de Petroleo in Rio Grande—each have 40 analog pneumatic control loops.

Blast furnace and basic steelmills sector.—The Brazilian steel industry includes 15 integrated mills, 21 semi-integrated mills, and 3 rolling mills. As of 1972 there were 65 companies in the sector with net assets greater than $1 million; of these, 15 firms had assets ranging from $25 million to $350 million. The five largest companies, whose combined sales amounted to $735 million in 1972, accounted for 58.6% of the sector's total.

Foreign participation in the steel industry is limited. However, Japanese firms own almost 19% of Usinas Siderurgicas de Minas Gerais S.A. (USIA MINAS), and other foreign holdings include a 30% share of Belgo-Mineira by Belgium/Luxemburg and a 72.4% interest in Mannesmann by a German company.

A massive infusion of capital into the Brazilian steel industry is predicted to raise output from its current annual level of 6 million MT to 20 million MT by 1980. Programs to expand production at the country's three major steelmills, at a cost of $690 million, were approved in 1972. These projects

should reach the completion stage in 1975, with a capacity of 2.5 million tons per year at the Companhia Siderurgica Nacional (CSN) mill; 2.4 million tons per year at the USIMINAS mill; and 2.3 million tons per year at the Companhia Sigerurgica Paulista (COSIPA) mill. Planned expansion from 1971 to 1976 may cost $1.7 billion.

Other companies besides the three largest steel mills also hope to expand capacity in the near future. Among these are Companhia Acos Especiais Itabira, Companhia Siderurgica Belgo Mineira, and Siderurgica Riograndense S.A.

Brazil's primary metals industries are expected to purchase $10.5 million worth of process control instruments in 1978, nearly tripling the 1972 level of $3.6 million. New projects now under construction will require an estimated 3,500 closed process control loops by the end of 1975.

Steel production in Brazil is utilizing more sophisticated instrumentation as the industry advances technologically. For example, there is a marked trend toward the use of electronic and partially computerized systems of control for blast furnace operations.

Duties and Trade Regulations

Brazil's tariffs on imported process control instrumentation are generally imposed at a rate of 15%. The exceptions are a 45% duty on iron and steel valves and thermostats and their parts, and 9% on all thermometers and their parts. Some industrial projects, carried out in the underdeveloped areas of Brazil, may be granted special concessions and import duties, and some internal taxes may be waived. Information concerning official duty rates applicable to specific products may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 4212, Main Commerce Building, Washington, D.C. 20230.

Instrumentation has not yet been reviewed by the Brazilian Standards Association. Instruments conforming to the standards of major industrialized countries are accepted in Brazil. Operating instructions, dial reporting, and registering printouts are preferred in Portuguese and metric measurement whenever applicable. Information on technical standards for process control instrumentation may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Table 4.—Brazil: Number of establishments by industry, 1972

Industry	Number of establishments (by net assets) Large (more than $50 million)	Medium ($5 to $50 million)	Small (less than $5 million)
Natural gas liquids....	—	7	1
Food processing	2	42	253
Paper and paper products	—	19	62
Chemical processing ..	1	69	123
Petroleum	3	13	14
Stone, clay, and glass	—	26	19
Primary metals	8	30	27
Utility services	16	49	28

Source: Bureau of International Commerce, Office of International Marketing research study.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Brazil to supplement this report is available on a continuing basis from:

Country Marketing Manager—Brazil
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202-967-5427

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market Process Control Instrumentation in Brazil," DIB 74-09-507, April 1974. The Office of Export Development also has available for $3.00 a "Target Market Trade List: Process Control Instrumentation—Brazil," which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

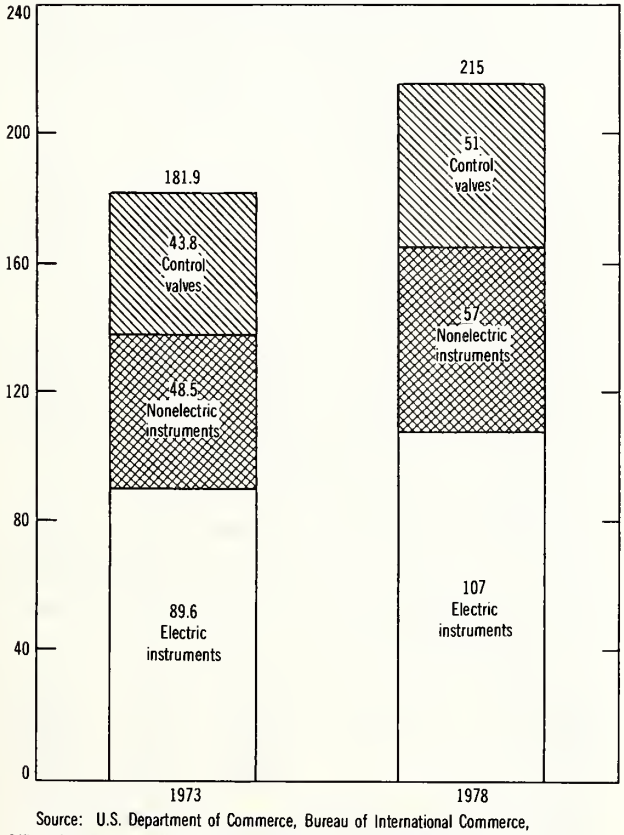
France

The French market for process control instrumentation is likely to grow in the coming years, due to industry's increased emphasis on automated control systems. The total value of the French process control instrumentation market rose from $108 million in 1970 to almost $182 million in 1973, achieving an annual average growth rate of 19.2% (see table 1). Projections show a control instrument market valued at $215 million by 1978.

Several factors underlie short-term market growth. French end-users are concerned about achieving optimal automation and control of their processes, and they are actively trying to improve existing plants and to design new and fully automated facilities. Another factor is the decision by the Electricite de France (EDF) to go ahead with construction of nuclear power plants. For safety reasons, EDF plans to double the number of process control instruments normally required for such a project.

France: Size of market for process control instruments, 1973 and projected 1978

(in millions of U.S. dollars)



Source: U.S. Department of Commerce, Bureau of International Commerce, Office of International Marketing research study. Values based on French trade source estimates.

Sales prospects for control instruments are considered excellent in the chemical industry, as well as in the petroleum and utility services industry. Almost 58% of the instruments sold in 1972 were purchased by these industries. A pronounced increase in the use of computers to control production has hastened demand for electronic equipment, most noticeably within the chemical, glass, oil, cement, and utilities industries.

Electric/electronic instrument sales in the 1970-73 period grew at an average annual rate of 12.4%, compared to 15% for nonelectric/nonelectronic instruments. More modest growth is forecast for the 1973-78 period, with estimates calling for an electronic instrument market of over $107 million by 1978 and for a nonelectronic instrument market of over $57 million. Consumption of automatic valves is expected to increase from a level of $44 million in 1973 to almost $51 million in 1978.

A growing share for U.S. firms.—French imports of process control instrumentation in 1973 approximated $179 million and are expected to rise to $205 million by 1978. It is noteworthy that while apparent consumption in 1972 was more than satisfied by production and imports, a significant share of imports was reexported. Most reexported equip-

ment goes to French engineering firms which are installing plants outside the country.

More than 25% of the equipment imported in the past several years was supplied by American manufacturers. The U.S. share is expected to increase to over one-third of the entire import market and, based on trade source estimates, will be valued at $72 million by 1978. In 1974, U.S. sales of control instruments, which comprised 28.6% of imports, amounted to $52.7 million.

U.S. firms are well entrenched in the French market; particularly strong are Foxboro, Honeywell, Fisher and Porter, Taylor Instruments, and Masoneilan. Along with sales of their subsidiaries in France, U.S. firms presently supply 35% of the country's process control market.

Technological refinements have given such U.S. products as transducers, strain gauges, valves, and analyzers an outstanding reputation in the market. This reputation is especially important because end-users tend to be very "brand" faithful and will purchase U.S. components even when they are more expensive than their French or German counterparts.

Government supports domestic production.—By 1978, domestic production will be valued at $173 million, representing a 12% annual increase over a period of 8 years. Exports in 1978 are expected to total $162 million, up from the 1970 level of $65 million.

French-owned manufacturing establishments account for approximately 40-45% of domestic production; the remaining 55-60% is derived from subsidiaries of foreign firms. Thirty percent of domestic production is exported. Most exports are made by engineering firms engaged in installing plants outside the country, an activity encouraged by the government.

The major domestically owned process control instrument manufacturing firms are Schlumberger, with sales of $18.1 million in 1972; Meci, whose sales totaled $14.5 million; Controle Bailey, with a $12.7-million volume; and Chauvin-Arnoux, with $2.7 million. Of these firms, Schlumberger produces the most comprehensive range of instruments, making virtually every type of sensor, transducer, converter, transmitter, controller, indicator, and recorder readout, as well as measuring and monitoring systems. Meci and Controle Bailey, the latter a manufacturing licensee of Bailey Meter Company, produce nearly as wide a range of components, and Chauvin-Arnoux manufacturers a slightly less inclusive line of control instrumentation. Several third-country firms, notably Siemens and Hartmann & Braun of Germany, and GEC-Elliott Automation and Kent of the United Kingdom, have subsidiaries in France. Together, their combined 1972 domestic sales amounted to $28 million.

France—Selected Indicators
(1973)

Gross national product:	**$248.4 billion**
Population:	**52.2 million**
Total country imports:	**$37.2 billion**
Total country exports:	**$35.8 billion**
Exchange rate (Feb. 1975):	**Fluctuating at about 4.34 francs = US$1**

The government has actively promoted expansion of the domestic process control instrument industry, contributing approximately $7 million in subsidies from 1966 to 1970. The bulk of these funds was spent to develop automated control systems in firms manufacturing sugar, dairy products, beer, plastics, and synthetics, and in the pulp and paper mills sectors. Total subsidies should increase to $16 million over the next 4 years.

Imports are expected to retain their importance in satisfying total domestic demand. Almost 75% of process control instrument imports in 1972 were supplied by manufacturers from three countries: Germany, with 36.2%; the United States, with 25%; and the United Kingdom, with 12.5% (see table 2). In 1972, imports from Germany totaled

Table 1.—France: Size of market for process control instrumentation, 1970, 1972-73
(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	24.8	40.5	64.3
Imports	66.2	96.2	104.7
Exports	36.5	61.4	78.4
Market size [1]	54.5	75.3	89.6
Nonelectric/nonelectronic instruments			
Production	24.5	30.0	38.9
Imports	22.3	30.5	38.7
Exports	19.2	23.4	29.1
Market size	27.6	37.1	48.5
Automatic control and regulator valves			
Production	14.8	20.5	24.0
Imports	20.2	27.4	35.5
Exports	9.6	14.0	15.7
Market size	25.4	33.9	43.8
Total process control instrumentation			
Production	64.1	91.0	126.2
Imports	108.7	154.1	178.9
Exports	65.3	98.8	123.2
Market size	107.5	146.3	181.9

[1] Market size equals production plus imports minus exports.
Source: Bureau of International Commerce, Office of International Marketing research study.

$56,238; from the United States $38,503; and from the United Kingdom $19,342. The German firms are particularly active in instrument sales to the French primary metals industry.

Major Industrial Users

An analysis of the eight major end-user industries conducted for the U.S. Department of Commerce, Office of International Marketing, reveals that combined 1978 consumption of process control instrumentation is expected to approach $162 million, up $36.2 million from 1972 (see tables 3 and 4). The eight surveyed industries purchased more than 85% of the control instruments sold in France in 1972. By 1978, the chemical processing and petroleum industries, as the largest users, are expected to account for over 50% of the process control instrument market.

Most of the firms throughout these industries tend to be small, having reported 1973 sales of between $2 and $13 million. Projected growth patterns for the food processing, utilities services, and gas and pipelines service industries, appear especially strong over the next 4 years. In the following paragraphs, the market potential for each of four most promising sectors within these major end-user industries is examined.

Chemical manufacturing sectors.—The industrial organic chemicals sector and the plastics and synthetics manufacturing sector have always been leading consumers of process control instruments. The two sectors constitute 25 to 30% of all French control instrument consumption, a share that is not expected to change significantly in the coming years.

Employees of these two sectors number 285,000 in 260 separate enterprises. At least 70% of the sectors' total sales were accounted for by large firms. Sixty percent of domestic manufacturers in these sectors are French-owned. The remaining portion is divided among German (30%) and U.S. subsidiaries (10%). Of the major process control end-users, those in chemical processing had the highest rate (10.5%) of expansion between 1972 and 1973; their level of consumption in 1978 is expected to exceed $7.5 million.

Under the chemical industry's new expansion plans, approximately five new manufacturing facilities will be built at a total cost of $300 million to $350 million; each unit will have 200 or so closed process control loops. The chemical processing sectors have always been heavily automated and use on-stream analyzers as well as process control computers.

Demand is particularly strong for the following process control instruments:

- Thermometers
- Pyrometers
- Manometers
- Strain gages
- Flowmeters
- Probes
- Densitometers
- Pneumatic/electric actuators
- ph redox meters
- Psychrometers
- Hygrometers
- On-line oxygen analyzers
- Gas chromatographs
- Analog indicators and recorders
- Valves
- Regulators

The Laverce plant (of Naphthachimie, a subsidiary of Rhone-Progil and Societe Francaise de Petroles B.P.) provides an insight into the present state of French chemical processing industries and their capacities for process control instrument consumption. The main products are ethylene (550,000 tons per year) and propylene (330,000 tons per year). Total process control instrument investment in 1972 approached $2 million. There are an estimated 200 closed loops in this chemical plant.

Electricity generation sector.—Need of the utility services industry for control instrumentation has

Table 2.—France: Imports of selected process control instruments by country of origin, 1970, 1971, and 1972

(in thousands of U.S. dollars)

	1970	1971	1972
Regulator, safety and pressure relief valves			
United States	4,897	5,980	6,945
Germany	5,915	8,113	7,993
Switzerland	696	1,055	835
United Kingdom	2,190	3,026	3,615
Italy	1,258	1,965	1,809
Total	14,956	20,139	21,197
Flowmeters, manometers, regulators, level indicators, and thermostats			
United States	2,707	2,515	2,512
Germany	5,999	7,639	8,989
Switzerland	642	979	831
United Kingdom	1,347	1,689	2,035
Italy	2,569	2,719	3,450
Total	13,264	15,541	17,817
Smoke and gas analyzers, photocells, calorimeters, porosity instruments			
United States	422	521	569
Germany	884	846	784
Switzerland	73	113	91
United Kingdom	284	279	297
Italy	123	181	197
Total	1,786	1,940	1,938

Source: French Customs Office.

Table 3.—France: Size of major industries using process control instrumentation

(in millions of U.S. dollars)

Industry	Sales 1970	Process Control Instrument Consumption 1972	1978
Chemical processing	7,142	62.4	76.0
Petroleum	4,996	19.5	25.4
Utility services	3,568 [1]	12.6	18.5
Primary metals	6,423	11.7	13.6
Food processing	2,898	5.8	9.7
Stone, clay and glass	2,120	5.8	7.8
Paper and paper products	1,437	5.8	7.8
Gas and pipeline services	173	1.9	2.9

[1] Includes both Electricite de France (EDF) and water services industries.

Source: Bureau of International Commerce, Office of International Marketing research study. Sales figures based on French trade source estimates.

increased as a result of the government's decision to proceed with plans for nuclear power production. The utilities services industry is expected in 1978 to purchase $18.5 million worth of process instruments, or 10% of total sales for that year.

The electricity generation sector itself, wholly owned and operated by the French Government's Electricite de France (EDF), comprises 10 plants employing some 120,000 persons. EDF boasted an impressive 8.9% growth in 1972, when its total production was over 150 billion kilowatthours (kWh). Industry sources report that 90% of all sales in this sector are accounted for by this single large firm.

The government's plan for the construction of nuclear power facilities calls for four power plants of 1,000 megawatts (MW) each to be built during the 1974-78 period, with total investments for control instruments estimated at $1 million per year. Process control instrumentation will be required to accommodate the expansion of direct digital control systems as planned; these systems will be installed in several new units yielding 1,000 MW each. The installation of approximately 400 closed loops (of which 25 will be main loops) for each unit is included in these plans.

A list of the most salable process control instruments for the EDF would include the following:

- Recorders
- Thermometers
- Flowmeters
- Level controllers
- Regulators
- Rotary flowmeters
- Manometers
- Level transmitters
- Electrical and chemical measuring devices
- Pressure and vacuum measuring devices

A typical EDF power plant is the thermal B Plant in Le Havre. Its present output is 850 MW, and when expansion is completed in 1980 the plant should product 3,250 MW. The plant features about 400 loops, 20 of them main ones, which regulate the four main variables: power, pressure, stream output, and hydrogen pressure of alternator. There are about 500 analog measures and about 2,000 "yes-no" measures, including 100 automated valves as well as 400 safety valves.

The EDF plans to subcontract the building of its new nuclear power plants to either Framatome, a Westinghouse subsidiary, or to CGE, a General Electric licensee. Each of these facilities will use on-stream analyzers and direct digital control systems.

Petroleum refineries sector.—Another sector with excellent prospects for process control instrument consumption is the petroleum refineries sector. The industry as a whole—with 1970 sales amounting to almost $5 billion—accounted for 13% of total French process control instrument purchases in 1972. Purchases of instruments by the industry came to $19.5 million in 1972 and are expected to reach $25.4 million in 1978.

Of the 50 firms in the French petroleum industry, 20 boast annual sales of over $45 million each, and 13 of the largest account for about 70% of total sales. The sector had a 1972 growth rate of almost 10%, an indication of its significant instrument market potential. Total output for that year was close to 100 million metric tons (MT). The French petroleum refineries sector is dominated by domestic manufacturers, which account for about 65% of total sales, compared to U.S. subsidiaries with 20% of total sales, and other foreign subsidiaries with 15%. Because of France's natural deep water ports for supertankers, it is anticipated that some fuel and gas consumed by other European nations will be refined in France in the coming years, and this would help sustain the sector's growth.

The petroleum industry's total capital investment in 1972 amounted to $500 million. For the 1974-78 period, the sector anticipates building four new units, each with a planned capacity of 4 million MT per year and featuring 250 loops, 10 of them main loops. Costs for capital equipment have been placed at between $100 to $150 million per unit.

As an industrial leader in the use of computers for process control systems, the petroleum refineries sector will have future plants almost totally run by computers, whereas existing ones are only partially computerized. On-stream analyzers and supervisory computer control systems will be in strong demand in the sector for the next 5 years, as will the following process control instruments:

- Devices for measuring for flow, humidity, liquid level, pH, and density
- Regulators
- Indicators, electric and electronic

- Pneumatic valves
- Thermometers
- Pyrometers
- Thermoelectric temperature measuring devices
- Manometers

Typical of the French refineries is the Societe de Raffinerie de Lorraine (SRL) at Hauconcourt, with a total output of over 4 million tons per year. Built at a cost of over $80 million, this plant features control instruments costing $4 million and computers valued at $1 million. The refinery contains 250 closed loops. A single control room features display screens, recorders, and 180 regulators. There are three computers, two of which are of Telemecanique manufacture and one Foxboro.

Blast furnaces and basic steel mills sector.—The primary metals industry's projected share of total process control instrument consumption for 1978 is $13.6 million, an increase over the 1972 level of $11.7 million. Of the 240 industry enterprises, 140 are small, with 1973 sales exceeding $40 million each.

The blast furnace and steel mill sector, which invested over $500 million in 1972, employs some 200,000 people. Production of cast iron in 1971 was about 19 million MT and steel production about 24 million MT. State ownership is predominant, as 85% of the sector's production falls under government control; U.S. subsidiaries accounted for only 3%.

The French Government has been energetically promoting the expansion of the steel mills sector, especially in the development of the Fos steel mill in southern France and the Dunkerque mill. Process control instruments most in demand here will be those dealing with computer control systems.

The Dunkerque plant, for example, is undergoing expansion plans that will boost production from 3 million MT to 8 million MT in 1976 and will include installation of approximately 100 highly automated closed process control loops. The project, already underway, is expected to absorb investments totaling $1 billion. These new mills will use the newer oxygen process for steel production. Combined expenditures for control instruments for the two mills are forecast to reach about $4 million by 1976. The control instruments used will for the most part be for temperature measurement (radiation pyrometers), and to a lesser extent for indicating pressure and material composition.

Duties and Trade Regulations

The French tariff structure for process control instruments partly reflects the country's obligations as a member of the European Economic Community (EEC). The five other original EEC members—Germany, Italy, The Netherlands, Belgium, and Luxembourg—pay no customs duty. For other European nations, however, customs taxes vary. Spain pays 40% of the normal duties, for example, while Great Britain, Ireland, and Denmark must pay 60% of normal duties. These taxes are to decrease by 20% each year and be eliminated by January 1, 1977.

For the United States, as for other countries, the tax varies according to the process control instrument product category. Duties range from 6.5 to

Table 4.—France: Number of establishments by industry and size by sales, 1973

Industry	Number of Establishments Large (over $45 million)	Medium ($13 to $45 million)	Small ($2 to $13 million)
Natural gas liquids....	6	12	10
Food processing	70	180	260
Paper and paper processing	20	40	110
Chemical processing ..	40	70	140
Petroleum	20	10	20
Stone, clay, and glass	5	10	30
Primary metals	30	70	140
Pipelines service	3	10	10
Utility services	8	30	40
Instruments and related products	5	30	40

Source: Bureau of International Commerce, Office of International Marketing research study.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on France to supplement this report is available on a continuing basis from:

Country Marketing Manager—France
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-4504

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in France," DIB 74-09-515, September 1974. The Office of Export Development also has available for $3.00 a "Target Market Trade List: Process Control Instrumentation—France" which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

13%. In addition to these duties, a clearing tax of 2% of the customs duty is levied on all imports. Information on specific duty rates may be obtained from the Domestic and International Business Administration, U.S. Department of Commerce, Room 4012 Main Commerce Building, Washington, D.C. 20230.

According to the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018, there is presently no definite standard governing the sale or use of process control instrumentation in France.

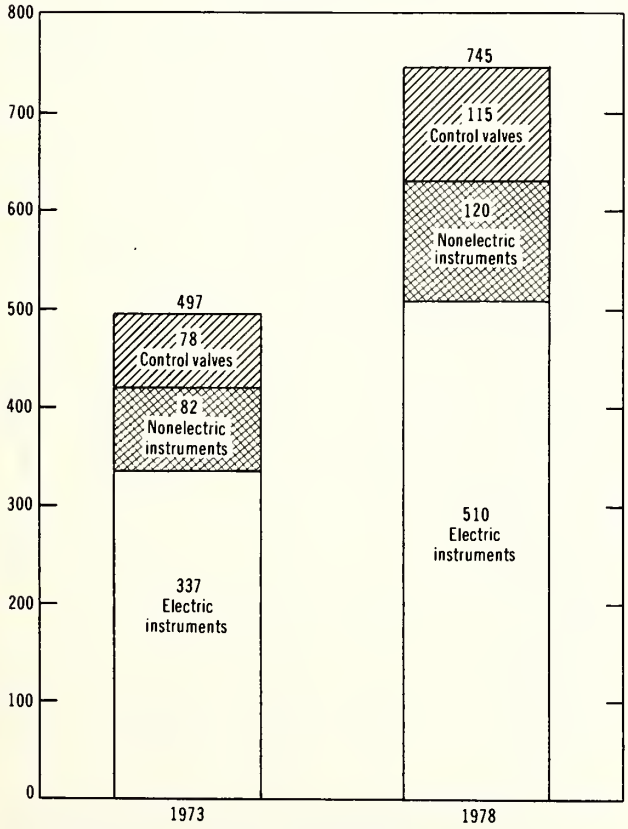
Germany

The German process control instrument market, influenced by anticipated expansion of the country's petroleum refining capacity and growth of the petrochemical industry, is forecast to reach a yearly level of almost $750 million by 1978.This represents an expected advance of 50% above the 1973 figure of approximately $500 million (see table 1).

Sales of process control equipment also are expected to increase in other sectors as the effects of rising oil prices are felt in the production budgets of other industries. Manufacturers are seeking ways to lower or compensate for the higher costs of energy; consequently, the rate of plant modernization, with much more efficient production controls, is expected to increase. The large-scale exploitation of nuclear energy as a power source should open extensive markets for appropriate process control instruments. As the character of the domestic end-user changes and as plants become increasingly automated, a rise in the market for large-scale and sophisticated computer-controlled systems is anticipated. The experience of American instrument manufacturers in this application area should give them a distinct advantage over their competition in the German market.

Germany: Market size of process control instruments, 1973 and projected 1978

(in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research study. Values based on German trade source estimates.

Rising wages in end-user industries have made capital investment in fully automated process operations increasingly attractive to managers anxious to hold down unit costs. Greater emphasis on pollution control is also expected to have a positive effect on sales of process control devices. An increase may be expected in new investments for process monitoring devices to maintain acceptable levels of emission in industrial wastes.

The average annual growth rate for sales of *electric/electronic process control instrumentation* between 1970 and 1973 was 14.8%, with the market rising from a level of $223 million to $337 million. Sales for 1978 are projected at $510 million. The market for *nonelectric/nonelectronic devices* is expected to maintain approximately the same 7.8% annual growth rate that it showed from 1970 to 1973 and to reach $120 million in 1978. Sales figures for *automatic valves* reveal a growth rate of 12.7% between 1970 and 1973. Purchases of valves, which totaled about $78 million in 1973, are expected to reach $115 million in 1978.

Germany—Selected Indicators (1973)

Gross national product:	**$347 billion**
Population:	**61 million**
Total country imports:	**$54.5 billion**
Total country exports:	**$66.8 billion**
Exchange rate: March 1975)	**Fluctuating at about US1$=2.33 DM**

Substantial U.S. sales growth foreseen.—Process control instrumentation imported into Germany in 1973 was valued at $121.3 million, or 24% of total sales. Imports for 1978, forecast at $205 million, are projected to supply a greater proportion of the total market—around 27%.

While American manufacturers are expected to supply approximately 25% of all process control instruments imported by Germany between 1973 and 1978, the dollar value of sales should almost double—from $30.7 million to $58 million—reflecting an average annual growth of 13.5%. The United States is the primary supplier of foreign-made goods to this market. This advantage is largely seen in the sales ($22.3 million) of American electric/electronic devices; the figure is more than twice the value of sales by the next supplier country, Switzerland. In other categories, competition is keener, but the United States is still the leading supplier of nonelectric/nonelectronic devices and ranks third in sales of automatic valves (see table 2).

The total sales and growth figures conceal the dominant role played by U.S. manufacturers in instrument sales to several specialized end-user sectors. In the primary metals and chemical processing industries, many American-made devices are technically superior to competing products and offer unique advantages to the German customer.

German purchasers, in addition to buying directly from U.S.-based manufacturers, trade with several American instrument makers who have subsidiaries in Germany—Foxboro-Deutschland, Fischer & Porter, Honeywell, Beckman Instruments, Taylor Instruments, Digital Equipment, Hewlett-Packard, and others. Taken together, these American subsidiaries command about 8.5% of the market.

Germany also major world supplier.—German manufacturers anticipate modest growth in domestic production of process control instrumentation in the near future. Currently, there are some 600 local companies making such devices. The firms range from industrial giants like Siemens AG and Messerchmidt-Boelkow-Blohm, for which these instruments are merely a sideline, to small companies entirely devoted to the production of one special type of process control instrument. The devices produced vary from the smallest components to fully computerized systems.

German manufacturers anticipate the value of domestic production will increase about 10% from 1974 to 1978.

Domestic suppliers export a significant portion of their instruments. In each year from 1970 to 1974, and in projections for 1978, the value of total production is greater than market size in each of the three major subcategories. In 1970, roughly 31% of all process control instrumentation produced in Germany was sold outside the country. Exports are expected to grow from $225 million to $400 million between 1973 and 1978. The bulk of this equipment is sold as constituent parts of the complete refining and processing facilities that the German chemical and metal industries install abroad.

German manufacturers of process control devices have the capability to meet most local needs and do account for some 75% of domestic sales, but German-made goods are relatively expensive. Imported instruments often present greater technical refinement, but at the same cost to the consumer. Several countries—Great Britain, Italy, and East Germany—also enjoy a distinct price advantage inside Germany because their currencies are low relative to the deutsche mark. GEC-Elliott of Great

Table 1.—Germany: Size of market for process control instrumentation, 1970, 1972-73

(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	237.6	291.0	383.8
Imports	47.2	55.7	78.3
Exports	61.8	94.2	125.2
Market size [1]	223.0	252.5	336.9
Nonelectric/nonelectronic instruments			
Production	88.1	90.2	121.3
Imports	22.5	25.7	33.9
Exports	45.4	59.1	73.6
Market size	65.2	56.8	81.6
Automatic control and regulator valves			
Production	60.5	75.0	95.8
Imports	6.3	6.6	9.0
Exports	12.2	20.0	26.7
Market size	54.6	61.6	78.1
Total process control instrumentation			
Production	386.2	456.1	600.9
Imports	76.0	88.0	121.2
Exports	119.5	173.2	225.5
Market size	342.7	370.9	496.6

[1] Market size equals production plus imports minus exports.

Source: Bureau of International Commerce, Office of International Marketing research study.

Britain has a subsidiary in Germany (at Solingen) that distributes and services products of DRELOBA (Dresdener Logik Bausteine VEB) of East Germany as well as its own goods. Other German subsidiaries of third-country firms are Mobry-Regler GmbH, Ferranti, and Kent-Deutschland GmbH, all of the United Kingdom; Carlo Erba SpA of Italy; Sprecher & Schuh AG and Camille Bauer Messinstrument AG of Switzerland; GST Regeltechnik GmbH of Sweden; Electrofact GmbH of the Netherlands, and Telemecanique of France.

Major Industrial Users

German purchasers of process control instruments represent a cross-section of light and heavy industry, but utility services and chemical processing together consumed 46% of all process control instrumentation purchased in 1972 (see table 3). Sales to the petroleum, primary metals, and instrument industries each amounted to 5% of total consumption. Research conducted for the Office of International Marketing, U.S. Department of Commerce, on the 10 largest end-user industries shows that they accounted for 68% of all process control devices sold in 1972. Within these industries, the sectors discussed in the following paragraphs were rated as excellent future markets for control instruments.

Utility services: electricity generation and distribution.—Almost 25% of all process control instrumentation sold in Germany in 1972—some $92 million worth—was purchased by the utility services industry. The industry provided $8.7 billion worth of goods and services in that year, and capital investment totaled $3.7 billion. Projections indicate that the utility services industry will continue to be a major purchaser through 1978, when their consumption of process control instrumentation is expected to reach almost $194 million.

Currently, there are 3,000 power companies employing 115,000 people in Germany. Of these, the 10 largest firms supply 55% of the total wattage consumed. Small power stations, with capacities under 100 megawatts (MW), supply not more than 7%. The need for electricity is rising. In 1972, some 221 million kilowatts (kW) were generated, for a total value of $5.5 billion. This figure represents an increase of 10% in output over 1971, and 1973 figures should show a further 10% expansion.

Electricity generation and distribution account for roughly two-thirds of the income and capital investments of the utility services industry. Capital investment in this sector jumped from $1.3 billion in 1970 to $3.3 billion in 1973 and is expected to rise to $6.5 billion by 1978.

Coal is the primary fuel used at present, accounting for almost 75% of the energy used and 48% of all electric power generated. The production of

Table 2.—Germany: Estimated imports of process control instrumentation by country of origin, 1973

(in millions of U.S. dollars)

	Electric/ electronic instruments	Nonelectric/ nonelectronic instruments	Automatic control valves
United States	22.3	7.0	1.4
Switzerland	12.4	2.8	1.9
France	9.7	2.7	.6
The Netherlands	7.3	6.6	1.7
Great Britain	6.5	3.7	1.0
Other Countries	20.1	11.1	2.4
Total	78.3	33.9	9.0

Source: Bureau of International Commerce, Office of International Marketing research study.

electricity from coal is to be subsidized by a special utilities tax. This tax will pay for construction of 10 large (600- to 700-MW capacity) coal-fueled power stations to be built by 1980.

The Government also subsidizes research on the uses of nuclear energy at a level of $550 million annually. In 1973, only 6% of German generating stations were fueled by nuclear power. Nine new stations with a combined capacity of 8,500 MW are currently under construction, and 14 more, scheduled to produce an additional 14,000 MW, are in the planning stages. The industry has set a goal of increasing the country's overall generating capacity by 90,000 MW. This will require the building of 100 new power stations by 1985. The new facilities are expected to cost $30 billion.

These new plants will require a wide variety of process control instrumentation, including the following:

- Integrated modular control and instrumentation systems
- Miniature control room elements
- Displays and plant diagram display modules
- Signal conditioners, analog and digital
- Analog-to-digital (A/D) converters
- Process computers and data loggers/interface
- Electrically operated control valves, maximum 80 db noise level
- Combustion and smoke gas analyzers
- Neutron flux detectors

Typical of the new nuclear-powered generating plants is the station at Biblis, which will generate 1,150 MW of electrical power with a water-pressure reactor. Four steam generators will produce 6,680 tons of steam per hour at a temperature of 265°C. The turbine will have one high-pressure stage and three low-pressure stages. There will be 6 control panels, 2,000 branch terminals, and 150 closed-loop controls. The process control system is made up of 270 cubicles; 96 for open-loop control, 104 for closed-loop control, 18 for data processing, 22 for alarms, and 30 for miscellaneous purposes.

Chemical industry.—In the chemical industry as

Table 3.—Germany: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Sales 1972	Capital investment 1972	Process control instrumentation consumption 1972	1978
Natural gas liquids	174	.38	2.2	5.2
Food processing	24,398	1,253	3.7	6.7
Paper and paper products	2,599	139	3.0	7.5
Chemical processing	17,955	1,392	79.0	152.7
Petroleum	5,870	285	20.4	44.7
Stone, clay, and glass	6,368	769	12.6	22.4
Primary metals	24,205	1,320	18.9	39.5
Pipeline services	810	47	3.0	6.7
Utility services	8,647	3,741	91.6	193.7
Instruments	456	55	18.5	37.3

Source: Bureau of International Commerce, Office of International Marketing research study.

a whole, there are 4,500 establishments, 95 of which employ more than 1,000 workers and are responsible for 60% of total production. Middle-range companies, employing 100 to 1,000 workers, number 550 and account for another 24% of the output. The remaining products are manufactured and sold by the many smaller firms (see table 4).

The industry is a principal consumer of process control instrumentation. Purchases of such devices for chemical processing in 1972 totaled $79 million, more than 20% of all process control equipment sold in Germany that year. Instrument sales to this sector in 1978 are expected to exceed $150 million.

Annual sales by the chemical industry in 1972 amounted to $18 billion, of which 8% or $1.4 billion originated with the subsidiaries of foreign companies. Of these, American-based firms account for almost $900 million, or 5% of total sales. The Dow Chemical Company is foremost among these foreign firms.

After several years of retrenchment, capital investment in the industry increased by approximately 10% in 1973. The increase in 1974 appears to have been even larger—15 to 20%. The average annual growth rate in capital investment for the years 1974 through 1978 is expected to settle in the neighborhood of 7 to 9%.

Corporate arrangements in the German chemical industry are quite complex, with three giant, multinational corporations—Bayer, BASF and Hochst—dominating. These three companies together account for more than 50% of total chemical production. Their published general figures for 1972 indicate that BASF, with all its international affiliates, did $4.4 billion worth of trade, of which $1.9 billion was sold by the parent company alone. For Bayer, the total was $4.1 billion worldwide and $2.1 billion through sales from its German plants. Hochst had sales valued at $4.3 billion in its entirety, with $2.8 billion of that originating with the purely German branches of the firm. Investment figures for 1972 for BASF total $300 million for the corporation as a whole, with $160 million for the parent company; Bayer invested $359 million worldwide and $200 million at home, and the Hochst company spent $465 million on capital investments for all subsidiaries and $259 million in Germany.

Organic chemicals.—Approximately 400 plants employing 40,000 workers are engaged in the manufacture of organic chemicals. Organic chemicals produced in Germany in 1971 were valued at $2.2 million (see table 5). The three big companies, BASF, Bayer, and Hochst, produce 50% of the total.

As in most of the chemical industry, capital investment in the organic sector, which is estimated at 15% of the total for the industry, is distributed two-thirds into modernization and renovation of existing plants and one-third into construction of new facilities (see table 6). Investments for 1972 came to roughly $205 million; 1973 investments were estimated at $265 million, and estimates for 1974 run between $315 and $335 million.

Prior to the advent of the petroleum crises, ethylene had been gradually replacing acetylene; this trend seems to be reversing. In addition, the conversion from cyclohexane to butadiene is being considered, but no specific installations changes have yet been reported.

Process control instruments needed in the organic chemicals sector include:

- Pneumatic/electronic control systems with interface
- Measurement center equipment, instruments and displays
- Direct digital controls (DDC) and process optimization computers
- Sampling devices for analytical instruments
- Electrochemical measuring equipment
- Thermal conductivity analyzers
- Paramagnetic oxygen analyzers
- Infrared gas analyzers
- Ionization detectors
- On-stream colorimeters and photometers

The trend is toward increased use of digitalized equipment. DDC systems and backup computers are also gaining in demand.

The Esso Chemie GmbH, a typical large plant, at Koln, produces 120,000 tons of ethylene per year, 85,000 tons of propylene, 20,000 tons of butadiene and 20,000 of butylene. The entire production process is controlled by two DDC computers which belong to the GE-PAC 4020 system. These have 32 K core storage and a speed of 300 variables per second. The cathode ray tube (CRT) displays for the four control consoles show actual, reference, and boundary values. A keyboard feeds new reference values for the closed loops in the computer. Time courses of process variables may be displayed on the CRT screen or printed out by a line printer. A second screen shows alarms or equipment failures, which may be localized and acknowledged. All alarms received, plus inputs for changing a computer function, are recorded on teletype. The process control system governs the following variables:

- Analog inputs (1,536)
- Analog outputs/DDC variables (512)
- Digital temperature-measuring values (512)
- External alarms (480)

Plastics and synthetic fibers.—The Association of the Chemical Industry reports that the value production in the plastic and synthetic fibers sector for 1971 amounted to $3.6 billion. Of this total, synthetic fibers accounted for $1.3 billion, polymerization products $1.2 billion, condensation products $735 million, cellulose plastics $186 million, synthetic rubber $162 million, and other plastics $585 million.

An estimated 450 German firms, employing some 50,000 people, are engaged in the manufacture of these products. The three largest—BASF, Bayer, and Mochst and their subsidiaries—command a 60% share of trade. The largest foreign-based corporation in this sector in Germany is ENKA Glanzstoff, a Dutch firm. Dupont is the leading American subsidiary, accounting for approximately 5% of sector sales.

This sector of the chemical industry is particularly vulnerable to the uncertainties and shortages associated with the energy crisis, as it uses petroleum products for raw materials as well as fuel. There was a slowdown in the market for synthetic fibers from 1970 to 1972. Starting in 1973, a recovery began, sparked by the precipitous rise in the prices of natural fibers. Currently, although demand is heavy, plants in the plastics and synthetic fibers sector are still not working at capacity because raw materials are in short supply. Nevertheless, managers are expanding their future capital investment plans. They anticipate that price increases for their own products will more than cover the higher costs of raw materials. Estimates made by industry

Table 4.—Germany: Number of establishments by industry and employment size, 1972

Industry	Number of Establishments		
	Large (over 1,000 employees)	Medium (200-999 employees)	Small 1-199 employees)
Natural gas liquids (including crude oil exploitation)..	—	11	63
Food processing	48	533	8,663
Paper and paper products	9	160	1,821
Chemical processing	95	299	4,099
Petroleum industry (including pipeline services)	7	38	85
Stone, clay, glass....	10	181	8,519
Primary metals	117	324	1,600
Utility services [1]	14	225	5,738
Instruments	10	140	450

[1] Figures for the year 1970.

Source: Bureau of International Commerce, Office of International Marketing research study.

spokesmen indicate that capital improvements valued at $370 to $400 million were made in 1974. Included in these are projects shown in table 7.

Process control instrumentation required by manufacturers for plastics and synthetic fibers includes:

- Transmitters for temperature, flow, level density and pressure
- Level switches
- Alarm systems
- Barton cells
- On-line gas chromatographs
- On-stream analyzers for gaseous media
- Flow controllers
- Mixture regulators
- Digital sequential control equipment
- Pneumatic control valves
- Extruder screw controls and head-pressure transducers

A typical modern German plastics factory, the polyvinyl chloride (PVC) plant of Huls Chemical Works in Marlberg, consists of 10 mixers connected to 6 dosing stations, and 80 reactors which are divided in 10 streets at 8 boilers each. Production capacity amounts to some 110,000 tons annually.

A Foxboro DDC computer system (PCP-88) at the plant features two central 8 K computers, one operating and one reserve. The working one alone handles control and regulation of the installation. The backup computer follows and monitors operations of the system itself and of the working computer, so that it can take over instantly, in the event of a breakdown. The two computers, when operating simultaneously, receive information by a single data input system and can communicate with each other by a separate system.

The input and output system comprises the following:

Table 5.—Germany: Production of organic raw materials, 1971

Product	Value
Aromatic hydrocarbons, not chemically uniform	22.4
Hydrocarbons, chemically uniform	307.5
Halo-, sulfo-, nitro-, and nitroso-derivatives of hydrocarbons	141.0
Alcohols [1]	209.2
Phenols [1]	63.4
Ether [1]	68.3
Aldehydes and ketones	83.9
Carbonic acids, including their salts and esters	409.7
Amines and other nitrogen-function organic compounds	364.5
Heterocyclenes and organic-inorganic compounds	204.1
Purified and refined natural resins	13.5
Waxes	44.0
Industrial oils, fats, and fatty acids	147.5
Natural volatile oils and aromatics	13.5
Other organic chemicals, including crude-phenols and products of wood distillation	115.9
Total organic chemicals	2,208.4

[1] Including their halogen-, sulfo-, nitro-, and nitroso-derivatives.
Source: German Association of the Chemical Industry.

- 256 analog inputs
- 828 contact inputs
- 43 impulse-counter inputs from volume counters
- 82 analog outputs for closed loops
- 864 contact outputs for valves, pumps, mixers

The computer system performs the following major functions:

- Calculates production orders for the mixing stations according to the stored recipes
- Controls production supplies to necessary accuracy by counting impulses from integrated volume counters
- Carries out reactor subprograms to fill with water, test density, cycle polymerization
- Regulates reactors by DDC on the basis of given temperature- and pressure-reference valves
- Corrects and adjusts on basis of alarm limits, when buildup of pressure occurs
- Provides summaries and printouts of daily production reports, alarm conditions, and reactor stop times
- Indicates operating conditions of mixers and reactors to aid operating personnel in their reviews

Petroleum industry: the refineries sector.—Germany is an oil importing country. With a 1972 output valued at $5.9 billion, which included pipeline services, the petroleum industry cannot provide all the products required by such a highly industrialized country. In 1972, there were 34 refineries in the country, owned by 10 companies and employing an estimated 52,000 people. In combination, 7,285 tons per year of petroleum products can be processed in catalytic cracking installations, 12,365 tons per year in thermal cracking installations, and 14,850 tons per year in catalytic conversion installations. The refineries cumulatively have potential production of 133 million tons annually, but their individual capacities vary. Of the 34, almost two-thirds are small, producing less than 5 million tons a year with marginal profits; in addition, one-third were built before 1962 and are in need of modernization.

Domestic demand, which stood at 175 million tons in 1972, exceeds present capacity and is expected to rise to 200 million tons a year by 1980. Even though increasing limits on pollution levels have raised both operating costs and the initial price, and the uncertainties of present sources of supply may force the new facilities to operate below capacity for the short run, the industry plans to boost German refining capability up to where it meets domestic needs by 1980. Items of process control

Table 6.—Germany: Selected capital improvements in organic chemicals sector

Company	Site	Planned production	Number of closed loops (est.)	Cost in $ millions (est.)	Start of construction
BASF	Ludwingshafen	Hydrogen for hydration processes, etc.	500	40	1975
Hochst	Frankfort-Hochst	New plant and modernization of existing ones	400	35	1975
Dynamit Nobel	Siegburg	Dimethyl-terephthalate 120,000 tons per year	400	40	1975
Bayer, Leverkusen	Brunsbuttel	Hydrogenium, carbon-monoxides primary products for the dyes	300	Total project cost, 120; organic production plant cost, 20	
Bayer	Leverkusen and Dormagen	Modernization and expansion of production capacities for primary organical products	350	25	1975

Source: Bureau of International Commerce, Office of International Marketing research study.

Table 7.—Germany: Selected capital improvements in the plastics and synthetic fibers sector

Company	Site	Planned production	Number of closed loops (est.)	Equipment cost in $ millions (est.)	Start of construction
Bayer	Brunsbuettel	Desmodur (TDI) 60,000 tons per year	400	120 total 30 plastics	1975
Hochst	Kelsterbach	Expand polypropylene by 90,000 tons per year (HD replacing LD)	350	30	1974 (end)
Erdol-chemie	Koln	Ethylene oxide, butadiene, polyethylene, ethylene, acrylnitrite, propylene, benzol, toluol	350	25	1975

Source: Based on reports of the German Association of the Chemical Industry (Verband der Chemischen Industrie).

instruments in demand by the refineries are:

- Pneumatic controls
- Electronic control systems
- DDC and backup process computers
- Level controls and alarm systems
- Complete temperature measuring controlling equipment
- Throttle valves with actuators
- Diaphram and motor control valves
- Density measuring instruments
- Transmitters for process variables
- Computerized loading terminals
- On-stream analyzers for oil distillation products

Subsidiaries of foreign-based multinational corporations currently hold 60% of the German petroleum refinery sector. American-based firms own 30% of all the refineries, British and combined British-Dutch interests control another 25%, and Italians dominate in the remaining 5% of foreign investment.

In an effort to promote domestic manufacture in this sector, the Government has just concluded an agreement with Iran to build a large refinery (about 20 million tons a year) in the Persian Gulf. Two German firms, VEBA and Gelsenberg, have been consolidated into a "national" oil company which will build and operate the Iranian refinery.

Certain capital improvements are already underway in refineries within Germany. A typical large-scale refinery is the Ruhr-Raffineria of BP in Dinslaken, which can process 6 million tons of crude oil annually. Opened in late 1973, the installation has 68 closed loops controlling volumes, pressures, temperatures, and level transmitters. Process control devices include control valves, local pneumatic controllers, local volume indicators, level switches, and a panel with a console enclosed.

The control panel uses a rear-screen projector for flow diagram images, instead of a flow chart. Input and output cables feed into the cubicles, each of which contains an alarm and shutdown system, with the alarm signals transmitted by contact-free initiators. The safety system for the furnaces has a self-monitoring, two-channel system for all shutdown circuits.

On-stream analyzers used in the installation include:

- Distillation point analyzer for 5% and 95% naphtha/petroleum and gasoline
- Ignition point analyzer for naptha
- Cloud point analyzer for light and heavy gas oil
- Vapor pressure analyzer for gasoline

These are all regulated in a separate analyzer control room. The following are locally controlled on-stream analyzers:

- Chromatograph for the detection of C_5 in benzine
- PH measuring instruments for strip condensates
- Chloride ion analyzer for strip condensates
- Color alarm device for cloud benzine
- On-line oxygen analyzer for smoke or fuel gases
- Stack gas nephelometer
- Viscosimeter for heating oil
- Portable corrosion measuring instruments

Duties, Standards, and Trade Regulations

The tariff rates in force for goods imported from the United States range from 13% for electric/electronic process control instruments down to 6% for control valves. Chemical and physical analyzing instruments are subject to a 10% tariff.

The new Common Market members—Great Britain, Ireland, and Denmark—and the former EFTA countries—Sweden, Austria, Switzerland, Norway, Portugal and Finland—now enjoy a tariff reduction of 20%. These rates will gradually be reduced, in five stages, to zero.

Information concerning official duty rates applicable to specific products may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 4016, Main Commerce Building, Washington, D.C. 20230.

Equipment standards and recommendations of professional associations are published by the German Committee for Standards. Other technical associations also publish materials standards and codes.

Publications of the Engineers Association (VDE) may be obtained from VDI Beuth-Vertrieb GmbH, 1 Berlin 30, Burggrafenstr. 7. Correspondence to the Machine and Instrument Makers' Association (VDMA) should be addressed VDMA 6 Frankfort-Niederrad, P.O. Box 109.

With few exceptions, the metric system is used in German production. Electrical power customarily supplied is 50-cycle, single- and 3-phase power, and 220/360 voltage. The German Electricians Association (VDE) puts out Safety Standard 0100, which applies to all electrical installations. Copies are available from the association at VDE, Verlag GmbH, 1 Berlin 12, Bismarkstr. 33.

More particularly important to the production of process control equipment are the standards developed by the Working Group on Standards for Measurement Control Techniques of the Chemical Industry (NAMUR). These may be obtained from Normenausschuss Mess-und Regeltechnik im Verband der Chemischen Industrie, 6 Frankfurt, Karlstr. 21.

Equipment to be operated in or with especially dangerous substances such as explosives or in hazardous processes (involving high pressure or radioactivity) is subject to inspection and regulations requiring special licenses. The Physikalische Bundesanstalt (Federal Inspection Office) in Braunschweig, and the TUV (Technical Control Association) are the responsible agencies for the licensing and control of such equipment and installations.

In the United States, information about German standards is available from two sources: the A.S.A. Standards Institute, 10 E. 40th St., New York, N.Y. 100016, and the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Germany to supplement this report is available on a continuing basis from:

Country Marketing Manager
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-4414

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

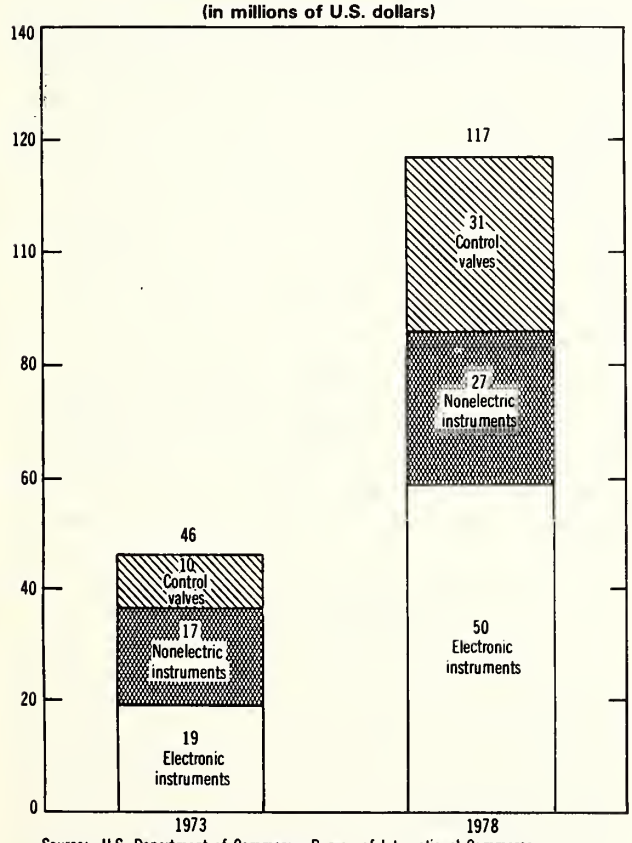
Please request: "The Market for Process Control Instrumentation in Germany," DIB 74-07-501, April 1974. The Office of Export Development also has available for $3.00 a "Target Market Trade List: Process Control Instrumentation—Germany," which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

Iran

Large-scale investment projects in Iran's processing industries should result in the control instrumentation market rising rapidly from $58 million in 1974 to $117 million in 1978, an average annual increase of more than 19%. Sales doubled between 1970 and 1973, rising from $23 million to $46 million (see table 1).

Iran's economic goals are based upon the maximum expansion and development of the oil and gas industries. The country's National Petrochemical Company will invest almost $8 billion over the next 13 years to construct facilities for the production of petroleum feedstocks. Under the Fifth Plan (1973-77), $1.4 billion will be invested in the natural gas industry, and Iran hopes to become a major exporter of liquefied methane by early 1978. In addition, the country's installed generating capacity of electricity is expected to triple by 1977, and $1.7 billion will be devoted to major improvements in the water supply.

Iran: Size of Market for Process Control Instrumentation, 1973 and projected 1978



Source: U.S. Department of Commerce, Bureau of International Commerce, Office of International Marketing research study. Values based on Iranian trade source estimates.

The oil-based industries and the publicly owned utilities are increasing their use of *electric/electronic* instruments. Purchases of this equipment, which accounted for only 30% of the 1970 process instrumentation market, should amount to over 50% of total sales projected for 1978. The market for electric/electronic devices is expected to expand by over 20% annually from 1974 to 1978, rising from $26 million to $59 million. Sales of *nonelectric/nonelectronic instruments* are forecast to grow by 9% per year, reaching $27 million in 1978.

Demand is predicted to be particularly strong for *automatic control valves*. From a meager $5-million level in 1970, sales climbed rapidly to $13 million in 1974 and are expected to grow by 24% per year, reaching $31 million in 1978.

U.S. firms major suppliers.—Iran is almost entirely dependent upon foreign manufacturers to satisfy its requirements for process control instruments. U.S.-designed equipment has achieved a high market penetration, partially because Iran's hydrocarbon industries are based on American technology.

Despite some increase in local production between 1974 and 1975, most of the demand for process control instruments should continue to be satisfied by foreign manufacturers. Such companies

Iran—Selected Indicators (1973)

Gross domestic product (1972):	$17 billion
Population:	31.3 million
Total country imports:	$3.4 billion
Total country exports:	$6.9 billion
Exchange rate (Dec. 1974):	Fluctuating at about 71.4 Iranian rials= US$1

as Foxboro, Honeywell, Taylor Instruments, and Fisher Control are expected to remain the chief suppliers to the market, since many Iranian engineers and designers have been trained in the United States and therefore prefer instruments of U.S. design.

Many American manufacturers also supply the Iranian market through manufacturing subsidiaries or licensees in Europe or Japan. Japanese joint-venture partners in Iran, for example, may order process control equipment from Yamatake-Honeywell rather than from its U.S. parent company. GEC-Elliott of the United States has a number of licenses from U.S. firms, including one from Fisher Control Co.

Instruments of special design or quality are often imported directly from the United States. Sales of American-made metal valves for liquid flow regulation amounted to almost $2.5 million in 1972, an increase of 56% over the 1970 level of $1.6 million (see table 2). Other 1972 imports from American manufacturers included fluid control equipment, worth $690,000; and automatic regulators, valued at $433,000.

European competition strong.—Germany, the United Kingdom and Italy are the leading European suppliers of process control instrumentation to the Iranian market. Hartmann and Braun and Siemens (Germany) have successfully penetrated the market. Siemens, in particular, has supplied the instrumentation for several Iranian power plants built by German firms. The George Kent group (United Kingdom) has provided some of the instrumentation used by the petroleum industry and in gas liquefaction plants.

Domestic manufacture of process instrumentation has heretofore offered limited competition because it was confined to the assembly and building of panels by Iranian subsidiaries of Siemens, Westinghouse, and Brown Boveri, and by the Instrument Service Company of Iran Ltd. (ISCO). It is worth noting, though, that ISCO recently received financial backing from the State-owned Industrial Credit Bank to set up manufacturing facilities for process control instruments. The firm intends to begin making chart recorders and pressure switches in 1976 and, in the following year, to produce timers and temperature controllers. ISCO expects to achieve a sales volume of $10 million in 1977.

Major Industrial Users

A market study recently conducted in Iran for the U.S. Department of Commerce, Office of International Marketing, reveals that the seven surveyed user industries accounted for about 94% of the country's total process instrumentation market in 1972. Iran's combined purchases, valued at over $31 million in 1972, are expected to increase by over 23% annually, reaching $109 million in 1978 (see table 3). Following sharp increases in the worldwide price of oil, Iran is currently revising its industrial investment allocations upward, and so purchases of process control instruments could rise at a faster rate than predicted in the study.

Of the top seven end-user industries, three have been highlighted as the most promising markets for process control instruments during the 1974-78 period. These are chemical processing, natural gas liquids, and utility services, which together should account for over 61% of the process control instrumentation purchased in Iran in 1978. These end-users receive priority treatment under Iran's Fifth Plan and will experience considerable growth over the next several years.

Chemical processing industry.—The Iranian Government hopes to maximize the use of hydrocarbon resources by processing them to the greatest possible extent within the country. One of the goals of the Fifth Plan is to build a strong, integrated chemical industry and, in particular, to develop the production of olefins and aromatics. Consequently, trade sources forecast sales of process instrumentation to the chemical industry to grow by 35% annually, soaring from $4.8 million in 1972 to $27 million in 1978.

All the companies engaged in chemical processing in Iran are wholly or partly owned by the State holding company, the National Petrochemical Company (NPC), which is a subsidiary of the National Iranian Oil Company (NIOC).

The NPC, created in 1961 with the establishment

Table 1.—Iran: Size of market for process control instrumentation, 1970, 1972-73
(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments	7.3	11.8	19.0
Nonelectric/nonelectronic instruments	10.5	14.9	17.0
Automatic control valves	5.1	6.6	10.0
Total process control instrumentation	22.9	33.3	46.0

Source: Bureau of International Commerce, Office of International Marketing research study.

of the Iran Fertilizer Company, now has only two establishments involved in the manufacture of organic chemicals. The first, Abadan Petrochemical Company, produced 20,000 tons of polyvinyl chloride, 12,000 tons of dodecylbenzene, and 24,000 tons of caustic soda in 1972. The second firm, Shahpur Chemical Company, produced 150,000 tons of urea and 250,000 tons of sulfur during the same year.

During the 1970-72 period, the chemical industry spent only about $75 million annually on maintenance and modifications of existing plants. By contrast, the Iranian Government's Fifth Plan calls for a minimum investment of $1 billion during the 1973-78 period.

Iran hopes to expand its production of organic chemicals through a series of joint ventures with foreign partners. The Iran-Japan Petrochemical Company was formed by the NPC and a consortium of Japanese companies in April 1972. The firm's planned facilities, scheduled for completion in mid-1977 at Bandar Shahpur on the Gulf, will become the largest chemical processing complex in Iran. Total investment in the project is expected to amount to approximately $800 million. The plant's yearly output should include the following: 170,000 tons of ethylene dichloride; 150,000 tons of vinyl chloride monomer; 100,000 tons of high-density polyethylene; 60,000 tons of low-density polyethylene; 50,000 tons of polypropylene; 30,000 tons of propylene; 145,000 tons of benzene; 150,000 tons of cumene; 93,000 tons of styrene; 40,000 tons of styrene-butadiene; 250,000 tons of caustic soda; 20,000 tons of ortho-xylene; and 100,000 tons of para-xylene.

In addition to investment in the Iran-Japan Petrochemical Company, the Fifth Plan allocates $932 million for the petrochemical industry over the 1973-78 period. An estimated $651 million of this total is intended for organic chemical projects, including the following: $512 million on an olefin and aromatics plant; $60 million on production of dimethyl terephthalate and polyester; $55 million on isoprene and polyisoprene; $15.5 million in petroprotein; and $8.5 million on styrene monomers. Some additional products to be manufactured are shown in table 4.

NPC projects also involve substantial investment in petroleum feedstocks, totaling $7.8 billion during the 1973-86 period (see table 5). The Iranian Government's plan for the next 13-year period calls for the development of a refinery to produce naphtha for subsequent conversion to basic petrochemical intermediates such as aromatics. The proposed refinery would convert 40% of its throughput of 600,000 barrels per day (bbl/d) of oil plus 1,200 million standard cubic feet per day (SCFD) of gas into petrochemical products. Trade sources anticipate additional construction of a large number of small plants to handle feedstocks and their derivatives, possibly involving joint ventures utilizing foreign capital.

Table 2.—Iran: Imports of selected process control instrumentation[1] by country of origin, 1970-72
(in thousands of U.S. dollars)

	1970	1971	1972
Metal valves for liquid flow regulation			
United States	1,638	1,147	2,516
Germany	2,415	2,463	3,782
United Kingdom	1,079	1,615	4,217
Italy	1,530	1,665	3,122
Other	1,287	1,634	4,061
Total	7,949	8,524	17,698
Fluid control equipment			
United States	368	479	691
Germany	802	918	961
United Kingdom	392	776	512
France	217	297	1,365
Other	1,005	1,463	1,772
Total	2,784	3,933	5,301
Automatic regulators			
United States	217	112	433
Denmark	113	468	775
Netherlands	73	142	73
Switzerland	127	141	332
Other	257	142	31
Total	787	1,005	1,644

[1] Categories may include items which are not considered strictly process control instrumentation.

Source: 1970 and 1971 data based on Iranian import statistics. 1972 estimates based on official 9-month import statistics.

The projects will require substantial investments in process control instruments. The use of electronic analog control systems is expected to increase rapidly. Demand should also be strong for on-stream analyzers, particularly for chromatographs.

The control system used by the Shahpur Chemical Company are characteristic of the technological level achieved by the sector as a whole. The Shahpur complex, which includes a number of plants engineered by Kellogg International Corporation, was originally equipped with pneumatic controls; the firm's new plants are electrically controlled. Each separate production unit is associated with an individual analog loop, with instruments in the control room. The large unit has 300 closed loops; the smaller includes 150 closed loops. Planned extensions of five new plants involve the addition of approximately 1,000 closed loops. Digital instrumentation and supervisory computers are expected to be used extensively in the future. The company's major process instruments suppliers are Foxboro, Honeywell, and Yamatake-Honeywell. Fisher valves and some Bailey instruments are used on boilers and steam mains.

Table 3.—Iran: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	New capital investment 1972	Process control instrumentation consumption 1972	1978
Natural gas liquids	80	4.9	22.4
Food processing	190	1.7	2.1
Paper and board	Negligible	Negligible	2.1
Chemical processing	100	4.8	27.3
Petroleum refining	100	3.9	15.3
Primary metals	440	12.7	17.7
Utility services	200	3.1	22.5

Source: Figures based on Iranian Fifth Plan, International Labour Office Report, and Iranian trade source estimates.

Water supply and irrigation systems.—The Fifth Plan stresses the development of Iran's nationalized energy and water resources. For example, electricity generating capacity is to be increased from 2,206 megawatts (MW) in 1970 to 6,200 MW in 1977. Water supply, particularly to urban areas, will be greatly expanded, and some of the country's semiarid land will be converted to farmland through irrigation. For these and other investment programs, the utilities industry will need a broad range of process control instrumentation. The industry is expected to be among the largest users of control instruments and valves, with purchases expected to total $23 million in 1978. The Ministry of Water and Power is responsible for the planned use of Iran's scarce water resources. An estimated 20,000 workers are involved in water systems administration in Iran, representing one-third of total employment in the Government-controlled utilities industry.

Investments by the irrigation and water supply sector totaled $313 million in 1974, with irrigation networks accounting for $178 million. Over the last 20 years, expenditures on dams, barrages, and wells amounted to $550 million. In 1971, Iran had 6 large reservoir dams, 21 diversionary dams and barrages, and 5,000 deep and medium wells, which together controlled about 8 million cubic meters (m^3) of water for agricultural and industrial use. The reservoir dams alone provide a regulated water supply for 230,000 hectares (ha) and irrigation water for 130,000 ha. In 1971, Iran's dams provided a generating capacity of 12 billion kilowatt-hours (kWh) per annum.

The Iranian Government plans to substantially improve the use of surface and subterranean water resources and to provide a reliable water supply for the country's urban population of 17 million expected by 1978. Facilities for the pumping and processing of 483 million m^3 of water annually are required to meet this goal. The Ministry of Water and Power is establishing regional water boards which follow the standard provincial administrative organization.

By the end of 1978, the country's total reservoir storage capacity should be around 9.5 billion m^3. The Fifth Plan forecasts the completion of additional reservoir dams with a capacity of 430 million m^3 annually and the initiation of new facilities to handle a further 2.5 billion m^3 per year. Iran expects to divert some 430 million m^3 of water from surplus areas to semiarid but fertile areas over the next several years (see table 6). Moreover, installations of facilities to extract 1,230 million m^3 of subterranean water are proposed. Between 1973 and 1978, appproximately $1.7 billion will be invested in water resources; of this, $1.6 billion will be public funds and $62 million will come from private sources. Expenditures on water supply projects are expected to amount to $421 million. Irrigation networks should account for $863 million in investment funds; $220 million is targeted for urban water supplies, $30 million on hydroelectricity, and $167 million on research.

The water control and regulation techniques used in Iran are similar to those employed in Europe and the United States. Foreign companies (for example, the U.S. company, Hawaiian Agronomics International; the British firms, Sir William Halcrow and

Table 4.—Iran: Selected projects in the organic chemicals sector

Product	Location	Capacity tons/year	Startup dates
Ethylene dichloride	Iran Petrochemicals, Bandar Shahpur	300,000	1977
Ethylene oxide	National Petrochemical Bandar Shahpur	n.a.	1978
Methanol	National Iranian Gas (Tansco Energy)	15 mil.	Early 1978
Nitrocellulose	State Authority	n.a.	n.a.
Phthalic anhydride	Iran-Japan Petrochemical, Bandar Shahpur	20,000	1976
Dioctyl phthalate	Iran-Japan Petrochemical, Bandar Shahpur	40,000	1975
Vinyl chloride	Abadan Petrochemical Abadan	42,000	n.a.
BTX (also ethylbenzene)	Iran-Japan Petrochemical, Bandar Shahpur	312,000 (200,000)	mid-1976
Ethylene	Abadan Petrochemical Abadan	24,000	n.a.
Ethylene	Iran-Japan Petrochemical, Bandar Shahpur	320,000	1977
Propylene	Iran-Japan Petrochemical, Bandar Shahpur	123,000	1977
Butadiene	Iran-Japan Petrochemical, Bandar Shahpur	28,000	1977
2-ethylhexanol	Iran-Japan Petrochemical, Bandar Shahpur	40,000	1975

Source: Data based on European Chemical "Chemoscope," March 8, 1974.

Table 5.—Iran: Selected feedback investments proposed by the National Petrochemical Company for the 1973-86 period

Product	Capacity in millions of metric tons per annum	Feedstock	Investment in millions of U.S. dollars
Ammonia (60% converted to urea)	5.5	700 million SCFD gas	1,100
Methanol	2.0	200 million SCFD gas	300
Ethylene dichloride	2.6	300 million SCFD gas	2,800
Ethylene from liquefied natural gas	3.0	350,000 bbl/d LNG	700
Aromatics/olefins from crude oils	2.1/2.4	From 600,000 bbl/d crude oil	2,900

Source: Data based on plans of the National Petrochemical Company, *Status and Future Prospects of Petrochemical Industries in Iran.*

Partners, and Sir Alexander Gibb and Partners; and Tahal of Israel) have designed and supervised the civil engineering and installation aspects of large water projects. During the next 5 years, feasibility studies on seawater desalination, recycling of treated sewage and effluent, and flood prevention are expected to be conducted. In the near future, the Iranian water resources sector will need many varied and sophisticated process control instruments, including the following:

- Electromagnetic flowmeters
- Weirs
- Flumes
- Float-operated instruments
- Mechanical water meters
- Chemical dosing measurement and control devices
- Residual chlorine analysers
- pH and specific ion meters
- Turbidity meters
- Multichannel water quality monitors, electric or chlorimatic

Iran's water supply and irrigation projects use open-loop supervisory control schemes based on telemetry, particularly for the remote control of pumping stations. The cost of the telemetry and supervisory system usually amounts to about 50% of the total instrumentation expenditure. In order to carefully control the country's scarce water resources, accurate metering of large flows, using differential pressure devices, is necessary. Dall tubes or electromagnetic flowmeters are used most often. Open-channel flows are metered by weirs and flumes. Flow is computed from the upstream level measurement, usually made by a float-operated instrument in a still well. Tanks and reservoirs also require very accurate level measuring instruments, and mechanical water meters are installed at all major points of use.

The Tehran Regional Water Board utilizes process control techniques considered typical for large installations in the sector as a whole. The plant was originally equipped with a central monitoring room for remote manual control of 26 reservoirs and pumping stations. There are approximately 300 analog and digital (on/off) measuring points, mainly for the measuring of flows, pressure, levels, electrical quantities, machinery status, and alarms. The George Kent Group is the major supplier of instrumentation. The remote supervisory system was purchased from Westinghouse Brake and Signal Co., and Motorola provided the radio telemetry.

The population of Tehran has grown from 1 million to 3 million since the system's installation in 1968, and so the water supply system has been expanded. Existing monitoring systems will be extended to cover all new plants to increase the degree of control. This system may be computer controlled, and some close-looped control and automatic quality measurements may be introduced, depending on the availability of trained maintenance personnel. The process control instrumentation will be utilized in a total of 40 reservoir sites and pumping stations, three water treatment works, and two large borehole developments.

Natural gas liquids industry.—Liquefied petroleum gas (LPG) is produced by the National Iranian Oil Company (NIOC) which has four refineries. One at Abadan has a throughput of 500,000 bbl/d of crude oil and most of the LPG is exported. The two refineries at Tehran have a combined throughput of 180,000 bbl/d and their LPG production is estimated at 7,000 bbl/d. The Shiraz refinery's throughput is 40,000 bbl/d, with LPG output around 1,700 bbl/d. The NIOC sells the LPG to the National Iranian Gas Company (NIGC), its subsidiary, and also to smaller companies which bottle and distribute the gas primarily to domestic customers.

Two small liquefied natural gas (LNG) units located at Agha Jari and at Marun on the Persian Gulf are operated by the Oil Service Company of

Table 6.—Iran: Dams under construction or study, 1973-78

Name of Dam	Height (in meters)	Capacity (in millions of m^3)	Area irrigated (in thousands of ha)
Lar	97	700	53
Talegan	68	195	80
Reza Shah Kabir	80	9,100	160
Marun	190	200	40
Minab	n.a.	n.a.	25
Jiroft	120	400	20
Nadar Shah	190	200	40

Source: Ministry of Water and Power.

Iran (OSCO). These two units received mixed natural gas in LNG form (1.27 billion ft³ a day in 1973) from the NIGC, blend it with crude oil, and export it. Also, the Kharg Petrochemical Company blends around 2,400 bbl/d of LNG with crude oil for export and recovers 7,000 bbl/d of LPG. Kharg's main activity, however, is using natural gas as a chemical feedstock; about 70 million SCFD of gas is presently being flared.

Since a modernized natural gas liquids industry is one of the primary goals of the Iranian Government, the Fifth Plan allocates $1.98 billion for investment in natural gas projects. About $1.4 billion should be spent on liquefied methane export plants; collection and transportation operations should receive $391 million; and distribution channeling are allocated $120 million. Refining operations are slated to receive $30 million, and $7.5 million is designated for improving rural supply methods. A national methane grid is now being constructed to serve towns and major industrial customers.

A substantial portion of the industry's expansion plan involves financial and technical assistance from foreign partners. The National Iranian Gas Company has formed pacts with Japanese and American concerns to operate the proposed new LNG plants. By 1978, Iran expects to become a major exporter of LNG by tanker, adding to its current practice of exporting only natural gas by pipeline. NIOC plans to produce 230,000 tons of LPG annually, mainly for domestic consumption.

Specific planned expenditures include $700 million for the construction of the Gach Saran plant and $800 million for the plant at Kangan. The Qishm Island methane liquefaction plant involves a Japanese company and, if approved, would entail an additional $800-million expenditure, bringing total investment in new projects to approximately $2.3 billion.

Iranian production of natural gas liquids generally follows usual oil refinery practices. Abadan is one of the oldest refineries in the world and has historically been one of the places where modern processing and control techniques have evolved. The newer refineries, which incorporate the latest technologies, plus facilities being constructed or planned, present a continuing demand for sophisticated process control instrumentation. The following products will be of special interest:

- Electronic analog control systems
- Control computers
- On-line analyzers
  —chromatographs
  —analyzers for physical properties of hydrocarbons and sulfur content
- Instruments for monitoring water purity and atmospheric contamination

The Rey refineries near Tehran are considered among the most advanced in the sector and have already ordered a supervisory computer from a U.S. manufacturer. Rey's two plants, constituting the largest refinery in the country, have at least 480 closed loops. Digital measurement is used on the flowmeter provers, and a few digital control loops are incorporated in the aviation fuel continuous blender. Between 30 and 35 on-line analyzers are installed in the two refineries. These instruments include an Arco specific gravity analyzer, a Foxboro pH analyzer, a Milton Roy dissolved oxygen analyzer, and a Johnson Williams atmospheric air monitor. Rey I has three control rooms with individual pneumatic controllers and Rey II has two control rooms with individual electronic controllers. Each has a thermocouple-actuated multipoint temperature indicator.

Duties and Trade Regulation

Tariffs levied on process control instruments imported into Iran are normally 25% of the c.i.f. value of the goods, except for thermometers on which a 10% rate is applicable. In addition, Iran assesses a commercial profit tax which, on imported process control instruments, ranges from 5% ad valorem on fluid meters to 20% ad valorem on valves and regulators. Taxes are not paid by Government-owned corporate buyers and, since most of the process control installations are in na-

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Iran to supplement this report is available on a continuing basis from:

John Haldane
Country Marketing Manager—Iran
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-3752

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in Iran," DIB 74-09-515, September 1974. The Office of Export Development also has available a "Target Market Trade List: Process Control Instrumentation—Iran" for $3.00 which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

tionalized concerns, they do not have a significant effect on imports of process control instruments.

Information concerning official duty rates applicable to specific products may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 5201, Main Commerce Building, Washington, D.C. 20230.

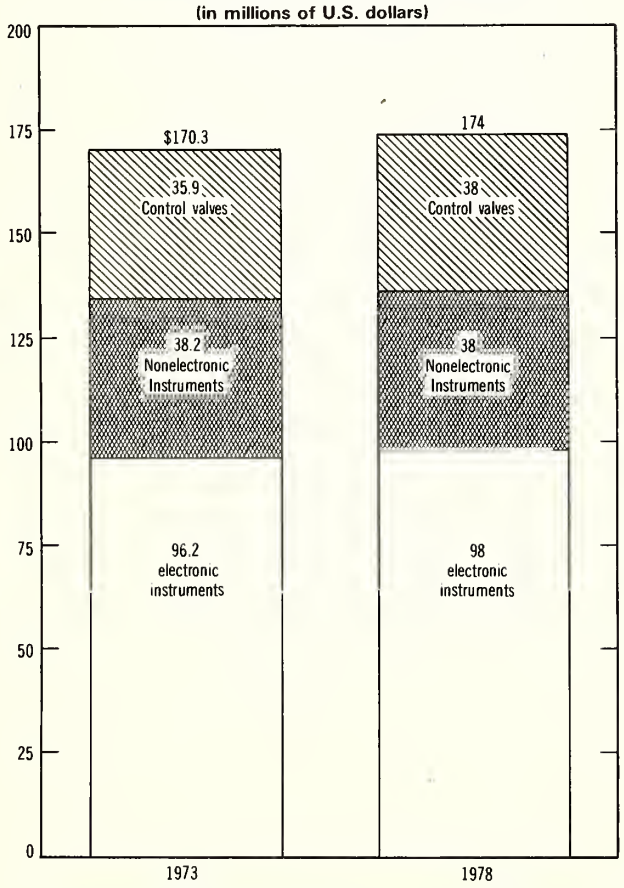
Iran's electrical supply is 220 or 380 volts, 3-phase, 50-hertz. The metric system of weights and measures is the standard.

There are no national standards governing the installation of process control instruments in Iran. Some of the large companies have adopted their own standards, but these are not mandatory; many standards of foreign origin are acceptable. For additional information on technical standards, contact the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Italy

The Italian market for process control instruments advanced rapidly in the early 1970's due to large-scale developments in major industries such as primary metals and utilities services. Sales of control instrumentation in 1973 surpassed $170 million, growing at an impressive average rate of 16% per year from the 1970 base of $109.4 million (see table 1). Basic industrial expansion will cause the process control equipment market to exceed $174 million in 1978.

Italy: Size of market of process control instrumentation, 1973 and projected 1978



Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Italian trade source estimates.

Italian firms, particularly those engaged in chemical processing and power generating, have been converting to more sophisticated apparatus to regulate their operations. The resulting upsurge in the *electric/electronic* process control instrument market caused sales to soar from $55.1 million in 1970 to $96.2 million in 1973, reflecting average annual growth of 21%.

The market for *nonelectric/nonelectronic* process control equipment increased at an average annual rate of 8% from 1970 to 1973, supported largely by paper and food producers and water treatment companies. Sales of these instruments rose from $30.5 million in 1970 to $38.2 million in 1973 but may level off over the next few years. Projections for 1978 show a $98-million market for electric/electronic instruments, and consumption of the nonelectric/nonelectronic category should approach $38 million.

New construction in the chemical processing and petroleum/natural gas industries has also contributed to a sharp rise in the Italian *automatic control valve* market. Sales reached $35.9 million in 1973, reflecting an average annual increase of nearly 15% over the 1970 level. The widespread expansion planned by several basic process industries could sustain a strong control valve market for many years. This market is forecast to reach over $38 million in 1978.

U.S. designs preferred.—Imports account for a major share of the Italian process control instrument market, with the United States as a major source of control items (see table 2). American designs are favored, whether imported from U.S. firms or from their European-based subsidiaries. U.S.

Italy—Selected Indicators (1973)

Gross national product:	$118.6 billion
Population:	54.5 million
Total country imports:	$19.4 billion
Total country exports:	$18.6 billion
Exchange rate (November 1974):	Fluctuating at about 666.6 Italian lira=US$1

items in greatest demand include data loggers, computer interface equipment, electronic controllers and systems including transmitters and potentiometric recorders, and on-line analyzers and process chromatographs for the petroleum and chemical industries. The preference for American designs is based on their superior quality and technology, including their good indicator and display characteristics; components are valued for their reliability.

The major U.S. process control instrument producers are well represented in the Italian market. Foxboro, Honeywell, Fisher Controls, Beckman Instruments, Bell and Howell, Control Components, the ITT Group, and Westinghouse (Motorola) have subsidiaries, marketing organizations, or other representation in Italy. American manufacturing subsidiaries account for approximately 25% of domestic production, and five U.S. firms are among the top 20 suppliers of process control instrumentation.

Three Italian-based U.S. firms manufacture (or assemble from imported parts) gages, measuring instruments, and local controls, as well as panel-mounted instruments and complete control systems. The largest of these, Sybron Italia SpA, a direct subsidiary of the Sybron Company, has about 150 employees and is known as a producer of recorders, pneumatic relays, and logic systems. Each of the other two firms manufacturing goods in these categories has 100 or so workers. Fischer and Porter Italiana SpA produces electromagnetic, turbine, and variable area meters. Leeds and Northrup Italiana SpA includes large, compact, and miniature potentiometric indicators and recorders in its product line, as well as digital temperature indicators and multipoint temperature data loggers.

One of Italy's major producers of on-line process analyzers is MSA Italiana SpA, a subsidiary of the Mines Safety Appliances Company of the United States. The firm's 200 employees manufacture or assemble on-line chromatographs, combustible gas analyzers, total hydrocarbon monitors, and a variety of other analyzers.

Nearly 25% of the process control valves made in Italy are produced by Masoneilan SpA, a subsidiary of the United States' Masoneilan International. The firm, located near Naples, employs 250 workers and manufactures a wide range of control valves, valve positioners, actuators, and level and pressure transmitters and controllers.

Northern Europe offers competition.—Italy also relies on European suppliers for process control know-how and sophisticated equipment; West Germany, the United Kingdom, France, and The Netherlands hold sizable shares of Italy's process control instrument import market. The leading European supplier of process plant instrumentation to Italy is probably Hartmann & Braun of West Germany. Fer H & B Misure e Regulazioni, with 100 employees, imports complete electronic control systems, miniature panel instrument/transmitter, local indicators, and potentiometric recorders and analyzers, and assembles some simple types of instruments from parts supplied by the parent company in West Germany. The firm also imports and sells other West German products such as Camille Bauer recorders and Wösthoff gas analyzers. Companies such as Schlumberger and OTIC Fischer, both of France, and West Germany's Schenk regularly export products to Italy. Other firms, including AEG (West Germany), Electrofact/Serck Controls and Philips/Withof (the Netherlands), and GEC Elliott/Fisher Valves (United Kingdom) have established Italian importing agencies. Siemens AG (West Germany) is an important source of process control devices for boilers, power stations, and steelworks.

Subsidiaries of European firms account for roughly 35% of Italian production of electric/electronic and nonelectric/nonelectronic process control instruments. Kent-Tieghi is the leading Italian manufacturer of these items. A joint venture of the United Kingdom's Kent Group and Italy's Tieghi, the 500-worker plant produces a full range of pneumatic instruments and assembles electronic transmitters, panel instruments, and complete electronic control systems.

Bosco and Company's 400 employees make locally mounted process control instruments under licenses granted by several European companies. Data Control SpA is a subsidiary of Switzerland's

Table 1.—Italy: Size of market for process control instrumentation, 1970, 1972-73

(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments	55.1	88.7	96.2
Nonelectric/nonelectronic instruments	30.5	42.2	38.2
Automatic control valves	23.8	34.2	35.9
Total process control instrumentation	109.4	165.1	170.3

Source: Bureau of International Commerce, Office of International Marketing research study.

Landis and Gyr, employing 250 persons; this Italian firm has become an important producer of solid-state logic, data loggers, telemetry, and remote supervisory control systems. A licensee of Alexander Wiegand (WIKA) of West Germany, the small (75 employees) Manometri Industriali S.r.l. manufactures pressure gages and assembles other WIKA products.

The entire Italian process control equipment industry, including foreign subsidiaries and licensees, consists of only 40 to 50 companies. Almost half of the companies have fewer than 100 employees, and many firms, even the larger ones, supplement their own production with imports from their parent companies or licensors. Italian-owned companies account for 30% to 40% of domestic output of electric/electronic and nonelectric/nonelectronic process control instruments, and about 75% of the automatic control and regulator valves.

One-half of the industry's 20 leading firms are Italian owned, including the Scientific Instruments Division of Carlo Erba SpA. This firm produces on-line chromatographs, total hydrocarbon monitors, and analyzers; it also represents Aqmel of France and VEB Dessau of East Germany.

Carlo Gavazzi SpA, a large Italian firm employing more than 1,000 workers, manufactures some products of its own design but also represents the United Kingdom, U.S., and Swiss companies and imports alarm switches and annunciators from Japan. Approximately 20% of its total output consists of process instrumentation such as solenoid valves and switches, measurement and control instruments (particularly solid and liquid level measures), and control systems for nuclear power stations.

Although considered one of the industry's leading producers, System Pan-Electric, a subsidiary of NCS Pan Electric, reports that only 10% of its total output consists of process control instrumentation. The firm's 700-man plant manufactures, among other items, multipoint digital temperature indicators, data loggers, and blending control systems.

Perhaps 40% of Spriano SpA's production consists of process control items such as pressure and temperature indicators, gages, thermometers, local pneumatic controllers, and recorders.

Two small Italian companies are also among the industry's top 20. Nuovo Fima SpA manufactures pressure gages, and Officine Orobiche SpA makes flowmeters, level and flow switches, indicators, and displays.

Four Italian firms, plus Masoneilan of the United States, account for virtually all domestic output of automatic control valves. Nuovo Pignone dominates this sector of the industry. The 1,000 employees at the company's large Valve and Instrument Division make all types of control and safety valves and produce complete pneumatic and electronic control systems, miniature and subminiature panel instruments, and telemetric devices. Nuovo Pignone also manufactures process controllers and computers under license from General Electric (United States).

The three other major valve producers are moderately small, ranging in size from 100 to 250 employees. Tartarini, Aleardo SaS specializes in liquefied petroleum gas (LPG) and liquefied natural gas (LNG) equipment. Its products include pressure regulators, pressure governors, pressure reducing stations for natural gas, and automatic stop valves. JSP-SpA manufactures Fluxotrol control valves, lo-

Table 2.—Italy: Imports of selected process control instruments by country of origin, 1970-72
(in thousands of U.S. dollars)

	1970	1971	1972
Selected apparatus and instruments for measuring, controlling, or regulating gases or liquids, or for automatic temperature control			
United States	2,411	2,611	2,383
West Germany	2,014	2,249	2,431
The Netherlands	1,987	2,019	1,307
United Kingdom	854	942	865
Other	1,258	1,386	1,062
Total	8,524	9,207	8,588
Potentiometric and other compensating electronic recorders			
United States	116	512	230
West Germany	133	138	228
France	29	45	—
United Kingdom	117	23	—
Other	66	129	158
Total	461	847	616
Electrical transducers for analysis of gases, liquids, and solids			
United States	61	87	163
West Germany	61	63	—
United Kingdom	47	60	—
Switzerland	5	6	—
Other	7	21	285
Total	181	237	448
Other electrical indicators, panel-mounted			
United States	173	172	429
West Germany	34	53	—
United Kingdom	3	13	—
Austria	8	2	—
Other	2	10	139
Total	220	250	568

Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Italian import statistics.

Table 3.—Italy: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Sales 1970	Capital investment 1970	Process control instrumentation consumption 1972	1978
Natural gas liquids ..	n.a.	30.0	1.8	1
Food processing.....	6,683.4	342.7	4.8	9
Paper and board	1,415.5	116.4	.7	1
Chemical processing	5,290.6	734.6	53.2	69
Petroleum	2,047.4	246.0	22.0	10
Primary metals	4,366.6	561.4	45.6	32
Utility services	3,154.8	1,232.0	18.0	25

Sources: Data based on the Instituto Centrale di Statistica: *Annuario Statistiche Industriali Vol. XVI* (1972 edition) and *Le Prospettive Dell' Industria Italiana nel Quadrienno 1972-75.*

cal pneumatic instruments, transmitters, large recorders and controllers, and miniature pneumatic control instruments. Parcol SpA produces pneumatic control valves, safety valves, and instruments for local control of level and pressure.

The Government indirectly assists the Italian process control instrumentation industry by officially instructing the nationalized user companies to buy Italian goods whenever possible, providing price and quality are equivalent to foreign equipment. In practice, these firms use considerable numbers of foreign-made instrumentation because of the limited range of equipment manufactured locally.

Italy's process control instrument industry has developed an export market, but imports of these items consistently exceed exports. Most of the exports are process plants and associated control instrumentation assembled by Italian contractors and sold to firms in Greece, Turkey, Yugoslavia, Eastern Europe, Africa, or the Arab countries.

Major Industrial Users

Research conducted in Italy for the U.S. Department of Commerce, Office of International Marketing examined seven major process control instrument user industries and their potential demand for U.S. products. Together, these industries accounted for 85% to 90% of Italian process control equipment purchases in 1970, when sales totaled nearly $23 billion. Their capital investments increased from more than $3.2 billion in 1970 to over $4.1 billion in 1971 (see table 3).

Three of the largest Italian basic process industries (chemicals, primary metals, and utilities services) employed 643,000 persons in 19,000 establishments in 1971 (see table 4). Their 1970 combined sales neared $13 billion, while capital expenditures rose from $2.5 billion in 1970 to $3.3 billion in 1971. These three industries collectively invested $117.4 million in process control instruments in 1970 and are expected to spend at least $126 million for control devices in 1978.

Industrial organic chemicals sector.—The chemical processing industry was the largest user of process control instrumentation in Italy in 1972 and its importance is likely to increase. Capital investment should range from $900 million to $1.5 billion annually through 1974. Consumption of control instrumentation is expected to climb from $53.2 million in 1972 to $69 million in 1978.

One-fourth (1,542) of the industry's establishments produce base chemicals (both organic and inorganic). These plants ranged in size from 17 large enterprises with over 1,000 employees to 887 plants with fewer than 10 workers. Sales in the industrial organic chemical sector reached $1.5 billion in 1971, and production of seven basic chemicals totaled 3.1 million metric tons (MT), distributed as follows:

- Ethylene (1,016,000 tons)
- Propylene (617,000 tons)
- Benzene (464,000 tons)
- Toluene (383,000 tons)
- Xylenes (334,000 tons)
- Acetylene (180,000 tons)
- Butadiene (106,000 tons)

The four leading chemical companies produce 80% of the sector's output. These firms, Montedison SpA, ANIC SpA, SARAS SpA, and Societa Italiana Resine SpA (SIR), are all Italian owned. American subsidiaries, led by Esso Chemical, account for less than 2% of sector production, and the one Belgian subsidiary, Solvey Italiana SpA, supplies less than 1%.

Annual capital investment in the basic organic chemical sector for the 1973-75 period is estimated at $400 million to $450 million. A national plan to coordinate investment in the industry was formulated in 1971 by Comitato Interministeriale per la Programmazione Economica (CIPE), based on guidelines prepared by the Instituto di Studi per la Programmazione Economica (ISPE). The objectives include the development of Sicily as the major ethylene production center, and the construction of new, large-capacity ethylene plants through cooperation among two or more companies. ISPE would like to see one new 450,000-ton-per-year ethylene plant added each year until 1980, along with annual closures averaging 90,000 tons annually. Other proposed construction would increase national production of acrylonitrile, protein concentrate, and n-paraffins. Liquichimica Augusta SpA will have the capacity (750,000 tons per year) to produce an estimated 40% of world output of n-paraffins when its expansion is completed in late 1974.

Construction of four new ethylene plants is expected to begin sometime in the 1975-77 period. Two of these, with approximate capacities of

Table 4.—Italy: Number of establishments by industry and employment size, 1971

Industry	Number of establishments: Large (over 1,000 employees)	Medium (100-999 employees)	Small (10-99 employees)	Very small (1-9 employees)	Total employees
Food processing	10	484	4,944	44,212	380,761
Paper and board	2	181	1,399	1,955	94,524
Chemical processing	30	392	1,906	3,942	248,965
Petroleum	2	45	110	124	19,186
Primary metals	34	306	1,380	2,117	241,754
Utilities	7	306	2,093	6,318	152,274

Source: Data based on statistics of the Instituto Centrale di Statistica.

400,000 tons per year, will be built by Montedison at Brindisi and at Priolo in Sicily. Each plant will use about 300 process control loops. The other two sites are in Sardinia. Rumianca Sud plans an installation capable of producing 370,000 tons per year, and Societa Italiana Resine SpA (SIR) should be able to produce 400,000 tons yearly. Both plants are expected to use 400 process control loops.

ANIC hopes to start construction of several new processing plants in Gela in 1975. The 80,000-ton-per-year acrylonitrile plant will probably cost $50 million and should include 160 control loops. The Gela site will eventually yield a maximum 20,000 tons of chloromethanes, 15,000 tons of ethylene oxide, and 32,000 tons of isoprene yearly. Some of ANIC's other projects for 1975 include two new plants at Ravenna to produce 40,000 tons per year of acetaldehyde and 23,000 tons per year of styrene monomer. The latter establishment will probably use 70 control loops.

Many other new plants are scheduled for construction during 1975 and 1976. SIR intends to invest $15 million in a 115,000-ton-per-year methanol plant at Sant'Eufernia; a 300,000-ton-per-year styrene monomer plant, using 100 control loops, will be built by Rumianca Sud at Cagliari, Sardinia; Montedison's Priolo site will include a new 120,000-ton-per-year acrylonitrile plant needing 175 control loops; and Italproteine is prepared to spend $50 million for a 100,000-ton-per-year protein concentrate plant at Sarroch, Sardinia.

Italian chemical producers have adopted American large-scale processing techniques, particularly in the industrial organic chemicals sector. Individual analog control loops and centralized control rooms are customary. The use of electronic controllers is increasing, and minicomputers are currently being installed with data logging systems. Comprehensive computer control was tried in the 1960's with limited success. Now, when computers are used with closed-loop supervisory or direct digital control facilities, they generally cover only a few critical control loops. The process control products promising the highest sales in this sector over the next 5 years include:

- Automatic on-line analyzers
- On-line chromatographs
- Oxygen gas analyzers
- Hydrogen meters (katharometers)
- Infrared gas analyzers
- Moisture meters
- Analog electronic control systems and related transmitters and receivers
- Minicomputer-based control systems operating mainly in the data logging or supervisory mode

A typical large process control system (600 closed control loops) was installed by ANIC SpA in its feedback refinery and ethylene plant at Gela, Sicily. This plant, with 250,000-ton annual capacity, uses individual pneumatic analog controllers supervised from a central control room. Five or six chromatographs analyze column-top products and furnace exit stream composition. The only digital instrument is a multipoint temperature indicator. Computers may be used in the future to log data and supervise control of set points.

Blast furnaces and basic steel mills sector.—Capital expenditure in the primary metals industry jumped over 68% from 1970 ($561.4 million) to 1971 ($950.9 million). In 1972, the industry accounted for nearly 28% of Italy's total consumption of process control instruments. Primary metal sales topped $4.3 billion in 1970, and in 1971 the industry produced 8.5 million tons of pig iron and 17.4 million tons of crude steel ingots.

The greater share of the industry's new capital investment for the next few years probably will go into basic steelworks. As of 1970, some 120 plants, with more than 79,000 employees, were engaged in steel production. The three largest steelworks, each capable of producing over 2 million tons of steel per year, accounted for 42% of 1970 steel output; three plants having annual capacities from 1 million to 2 million tons per year accounted for 21%. Altogether, steel output reached nearly 17 million tons that year.

The blast furnace and basic steel mills sector is almost entirely composed of Italian-owned companies. No U.S. subsidiaries, and probably fewer than five European subsidiaries, are involved in

basic iron and steel production. Six large state-owned companies, Achea, Breda Siderurgica and the Finsider group (Italsider SpA, Terni SpA, Dalmine SpA, and Societa Nazionale Cogne SpA) together with the largest privately owned company, Acciaierie e Ferriere Lombarde SpA (Falck), account for 70% to 80% of Italy's steel output.

Capital investment in basic iron and steel mills climbed from $196 million in 1970 to a $500-million peak in 1972 and was expected to level off at around $400 million annually during 1974 and 1975. Between 1974 and 1980, Italsider expects to spend $450 million to $550 million improving and enlarging its Taranto steelworks. Capacity will be expanded from 6 million Mt per annum to 10 million Mt, thus making this steelworks the largest in Italy. New construction will include five blast furnaces and associated basic oxygen furnaces (BOFs), continuous casting machines, reheat furnaces, soaking pits, and strip mills. The steelmaking process will be controlled by 25 to 30 closed loops regulating each blast furnace, 15 loops associated with each BOF plant, 15 loops for every continuous casting machine, 30 per reheat furnace, and 6 for each soaking pit.

Italsider also plans to upgrade the Gioia Tauro steelworks at a cost of $350 million. In the first phase, a 1-million-ton-per-year cold strip mill will be added; in phase two, a hot strip mill with a capacity of 3.6 million tons per year will be built. New electric furnaces with capacities of 500,000 tons per year will be installed to help feed the rolling mills.

Falck anticipates paying $50 million during the 1974-76 period for a modernization program that will ultimately increase the company's annual production by 5% to 10%, and create employment for another 450 workers. Two steelworks near Naples and several others in Northern Italy will be upgraded, and their old blast furnaces will be replaced by new electric furnaces.

The larger Italian iron and steel producers have adopted modern techniques and equipment such as basic oxygen steelmaking, continuous casting machines, and electronic analog controllers. Computers are used for supervisory control of blast furnaces, basic oxygen steelmaking, hot strip mills, and cold mills. Italsider's latest steelworks will incorporate four or five control loops into the blast furnace direct digital control (DDC) systems, and will use a DDC system to manage a battery of soaking pits. The process control equipment in highest demand over the next 5 years should include the following items:

- Gas analyzers for oxygen and hydrogen (thermal conductivity)
- Infrared gas analyzers for carbon monoxide and carbon dioxide
- Analyzers of pH, conductivity, and dissolved oxygen in water
- On-line chromatographs to measure hydrocarbons in liquid oxygen
- Nucleonic instruments to measure metal thickness
- Nucleonic instruments for on-line nondestructive testing
- Nucleonic instruments for level of molten metal

Italsider's Taranto Steelworks has a large process control system. The plant has a battery of five blast furnaces using individual electronic analog controllers with a supervisory computer. Each furnace has an individual control room, and the newer furnaces contain console panels for instrumentation as well as a motor control center. The system includes 130 closed loops for the 5 furnaces plus many additional temperature measures. From 15 to 20 flue gas analyzers measure oxygen content, hydrogen (by thermal conductivity) and carbon monoxide/dioxide (by infrared analysis). Computers are used for furnace charging operation calculations, data logging, and display.

Electricity generation and distribution sector.— The utility services industry, which spent $18.2 million on process control instrumentation in 1972, is expected to increase that investment at about 5% annually through 1978. A large part of the industry's capital investment ($1.3 billion in 1971) is spent in the rapidly growing electricity generation and distribution sector. Consumption of electricity in Italy is rising at a 7.5% annual rate. Ente Nazionale Energia Elettrica (ENEL), the national electricity authority, foresees a need to build 15 power plants over the next 5 years to keep pace with demand.

Italy's total installed generating capacity in 1971 was 31,330 megawatts (MW), with hydroelectric power plants accounting for 43% and the rest found in thermal, geothermal, and nuclear stations. ENEL and small local authorities produced and distributed 78% of the electricity in that year; the remainder was generated by consumers or "autoproducers," i.e., refineries, chemical plants, steelworks, and paper mills.

ENEL's investment in thermal power plants grew from $325 million in 1970 to $475 million in 1972. The 11 proposed new thermal stations, to be built as soon as sites can be officially approved, include three 1,250-MW plants, each costing about $180 million and having 140 closed loops; five 600-MW stations using 70 to 80 closed loops per plant, at an estimated cost of $90 million each; two 2,600-MW stations, using 160 closed loops and costing $360 million each; and one 300-MW unit with 80 closed loops, priced at around $50 million. ENEL also plans to construct four new nuclear plants at a combined cost of almost $2 billion. The 950-MW stations will use an estimated 300 control loops each.

ENEL has adopted many sophisticated practices in an attempt to meet the level of technology found with electricity authorities in other more advanced countries. Electronic analog controllers and central control rooms are in general use. Combustion controls feature complex cascade and analog computing loops, and some electronic logic circuitry is in use, with manual startup of boiler/turbine units. Computers are used for alarm and other data logging and new installations will incorporate computer sequencing and logic. The products with the highest apparent sales potential over the next 5 years include the following:

- Individual electronic analog controllers and system components
- Water circuit analyzers for conductivity, pH, and dissolved oxygen
- Combustion gas analyzers of oxygen content and smoke density

The power stations at Portatolle, Rovigo, is one of Italy's most modern installations. When completed, the Portatolle plant will be ENEL's largest, with the capacity for generating 2,600 MW from four 660-MW units fired by heavy oil and/or natural gas. Unit startup is manual. The process control system, with 160 to 180 closed loops, uses individual electronic analog controllers and a central control room. A data logger gives printouts of abnormal conditions. The power station uses six conductivity and two pH analyzers in the demineralized water plant, and seven conductivity, two pH, and one dissolved oxygen analyzer for the condensate treatment plant. Every boiler/turbine unit requires four conductivity, three pH, and three dissolved oxygen analyzers for each water circuit, and oxygen content and smoke density transmitters for boiler flue gas. All ENEL stations include complex ratio and analog computing control loops with many split range actuators.

Duties and Trade Regulations

Italy imposes four different duty rates on imports of process control instruments, plus a value added tax (VAT) amounting to an additional 12%. The full duty rate, ranging from 6% to 13%, is assessed on shipments from all General Agreement on Tariff and Trade (GATT) countries outside the European Economic Community, including the United States. Preferential rates, which will be phased out altogether by 1977, are given to the United Kingdom, Ireland, and Denmark. Information on specific duty rates may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 4016 Main Commerce Building, Washington, D.C. 20230.

The only mandatory standard for process control instruments is *CEI: 64-2 Regulations for Electrical Plant in Locations with Fire or Explosion Hazard.* Details are available from Comitato Elettrotecnico Italia, Viale Monza 259, 20100 Milano, Italy. While foreign certificates of intrinsic safety are usually adequate, the equipment supplier must also have an Italian Certificate from the Comitato Elettrotecnico Sperimentale Italia, Via Rubattino 54, 20100 Milano, Italy. Apart from electrical safety aspects, U.S. standards are generally acceptable. For further information on standards and proposed changes, contact the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Italy to supplement this report is available on a continuing basis from:

Country Marketing Manager
Office of International Marketing—Italy
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-3944

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in Italy", DIB 74-09-514, September 1974. The Office of Export Development also has available for $3.00 a "Target Market Trade List: Process Control Instrumentation—Italy" which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

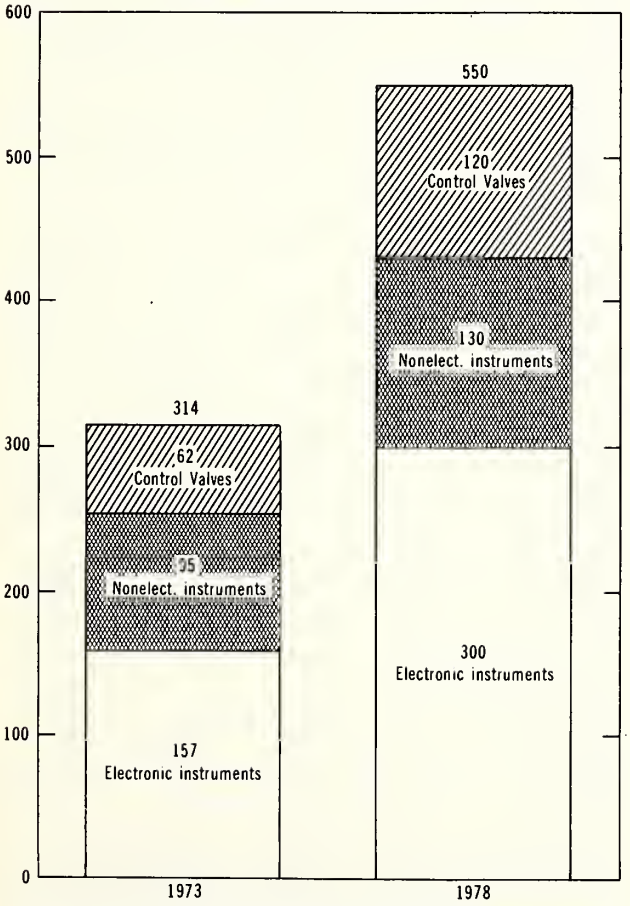
Japan

The Japanese market for control instrumentation, spurred by the necessity to expand production in the process industries, is forecast to rise by 12% annually during the next several years and reach an estimated level of $550 million in 1978. Demand for new instrumentation has already precipitated a sharp increase in sales from $220 million in 1970 to $314 million in 1973 (see table 1).

Much of the expansion planned for the process industries is an outgrowth of the higher world price for the crude oil that Japan must import; the Government is encouraging greater production of petrochemicals and steel for export to offset the. higher cost of imported oil. Additional resources also will be allocated to the construction of nuclear power plants in order to decrease the use of oil in the generation of electricity.

Japan: Size of market for process control instruments, 1973 and projected 1978

(in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research study Valves based on Japanese trade source Estimates.

Sales of electric/electronic instruments are expected to exceed $300 million in 1978, representing an almost 14% average annual growth rate over the 1973 level. The market for nonelectric/nonelectronic instruments should grow 6.5% annually, totaling an estimated $130 million in 1978. Purchases of automatic control valves are expected to nearly double between 1973 and 1978, rising from $62 million to $120 million.

U.S. sales should double.—Imports of process control instruments have continued to increase despite growing domestic production in Japan. The total value of foreign sales of control instruments in 1970 amounted to $25 million and in 1973 to $34.5 million, representing an annual growth rate of 11.1%. Imports should expand 15% annually from the 1973 level and approach $70 million in 1978.

Sales of American control instruments to Japan amounted to $22.2 million in 1970 and rose in 1973 to $28.5 million, or 83% of imports. American sales may be expected in the near future to increase substantially, growing an average of 14.7% per year and approaching a level of $57 million by 1978.

Electronic process control instruments are expected to offer the best sales opportunities for U.S. manufacturers. Imports of such devices from the United States should rise from $19.6 million in

Japan—Selected Indicators (1973)	
Gross national product:	$415 million
Population:	108.4 million
Total country imports:	$36.25 million
Total country exports:	$36.85 million
Exchange rate: (March 1975)	Fluctuating at about 287 yen=US$1

1974 to over $34 million in 1978, representing an average annual growth rate of 15%. The U.S. share accounted for over 90% of 1972 imports in some categories of electronic controls, such as pressure, flow, and liquid-level measuring instruments (see table 2). Japanese end-users are expected to purchase nonelectric instruments valued at almost $7 million from U.S. manufacturers in 1978. U.S. sales of automatic control valves should reach $15 million in 1978, a 150% increase over the $6.1 million level recorded in 1972.

U.S.-designed equipment also is purchased from Japanese manufacturers who operate under licensing agreements with American firms. Numerous U.S. firms also have entered into joint ventures with Japanese companies for the manufacture of control instruments. Yokogawa Electric Works, Ltd., in partnership with Hewlett-Packard Co. of the United States, is the largest domestic manufacturer of process control instrumentation in Japan (see table 3). Honeywell Inc. owns 50% of Yamatake-Honeywell Co., the largest Japanese exporter of control instruments.

Domestic control instrumentation output expands. —Some 680 domestic plants employing an estimated 56,000 workers produced 88% of Japan's requirements for process control instruments in 1970. Between 1974 and 1977, production is expected to expand by 10.3% annually.

The manufacturers can be classified into three groups. The first type, comprising eight firms, specialize in assembling systems for process control. Some of these companies, such as Yokogawa Electric Works, Yamatake-Honeywell, and Hokushin Electric Works, also contract to install instrument systems. This group holds a 70% share of the control instrument market. Second are large diversified companies such as Hitachi, Ltd., whose production of control instruments constitutes a small part of its total output. In the third category are numerous small-scale, specialized companies that make components or subassemblies and supply the first two groups.

As part of an overall program to develop new technology in the electronics industry, the Japanese Government provides some funds for research in electronic process control instrumentation. These Government subsidies are expected to continue until the electronics industry in general and process instruments in particular can compete effectively in the world market.

Licensing agreements, mainly with American firms, have been instrumental in improving local techniques, but a time lag still exists between U.S. and Japanese process control technology. Set-point control systems were introduced in Japan in 1959, and direct digital control (DDC) systems were first adopted in 1966. The Japanese have not yet reached a level that enables them to compete with the United States in designing process control systems. As evidence of this, the two largest steel companies are considering overseas sources for their advanced instrumentation.

Although exports are expected to grow at a rapid rate between 1973 and 1977, overseas sales will remain insignificant in comparison to the domestic market. Exports in 1978 should total over $21 million, less than 4% of the size of the domestic market.

U.S. companies are, by far, the dominant foreign suppliers of control instruments, maintaining a 95% share of Japan's imports. The remaining 5% originate from other third-country manufacturers, mostly in Germany, the United Kingdom and Sweden. Almost no complete systems are imported from these third countries, but some licensing and intercompany operating agreements do exist.

Table 1.—Japan: Size of market for process control instrumentation, 1970, 1972, and 1973

(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic			
Production	93.0	106.1	147.0
Imports	11.6	12.8	16.3
Exports	1.8	3.2	5.9
Market size [1]	102.8	115.7	157.4
Nonelectric/nonelectronic			
Production	76.1	70.7	90.1
Imports	5.9	5.6	6.7
Exports	.7	1.3	1.7
Market size	81.3	75.0	95.1
Automatic valves			
Production	29.1	36.3	51.8
Imports	7.5	7.9	11.5
Exports	.4	1.2	1.7
Market size	36.2	43.0	61.6
Total process control Instrumentation			
Production	198.2	213.1	288.9
Imports	25.0	26.3	34.5
Exports	2.9	5.7	9.3
Market size	220.3	233.7	314.1

[1] Market size equals production plus imports minus exports.

Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Japanese trade source estimates.

Major Industrial Users

Ten industries surveyed for the U.S. Department of Commerce, Office of International Marketing, were found to utilize 83.5% of the process control instrumentation sold in Japan. Sales to only four of these industries account for 75% of the market: chemical processing 26.8%, petroleum 18.5%, electricity generation and distribution 15%, and primary metals 14%. Utility services and primary metals are the largest in terms of capital investment (see table 4) and, with the other two key industries, are expected to account for 77.5% of control instruments sold in 1978.

Petroleum refining industry.—Petroleum is the primary source of energy in Japan. Capital investment by the industry reached almost $1.2 billion in 1972, when sales totaled over $10 billion. Investment by 1974 had grown to almost $2.4 billion, double the 1972 level. The industry spent over $200 million on refineries and almost $800 million on pollution control in 1974.

At the end of 1971, the industry employed 41,500 persons. In 1972, over 22,000 worked in the 32 refineries that produced almost 1.3 billion barrels (bbl) of fuel oil, 15.4 million bbl of lubricating oil, and almost 8.7 million tons of other products (see table 5). Output of petroleum products in 1972 totaled 1.3 billion bbl, or 4.9% more than in 1971 (see table 6). The largest 1972 increase of an individual product over 1971 output was 26.2% in jet fuel, and the only decline was 3.3% in kerosene production.

Foreign interests hold significant shares in petroleum refining in Japan. At the end of 1973, U.S. oil companies held 40.3% of refining capacity that accounted for 42.4% of domestic sales, compared with 48.4% of total capacity and 44.8% of sales held by the Japanese oil firms. British Petroleum also owns a major refinery in Japan.

In a report issued in September 1974, the Japanese Ministry of International Trade and Industry (MITI) announced that crude oil imports would increase over the next decade from the level of 1.8 billion bbl in 1973 to 2.5-3 billion bbl in 1980 and 3-3.5 billion bbl in 1985. This increase, however, would result in a decline of petroleum as a basic source of primary energy from the present 75% to somewhere between 60 and 65% by 1985, the report continued.

Plans for enlarging refining facilities already approved by MITI in November 1973 called for expanded capacity totaling 1.1 million barrels per day (bbl/d) in 14 plants to be completed by 1977. Showa Oil plans to invest $143 million in the construction of the Niigata plant. When completed in 1977, the refinery will have a capacity of 100,000 bbl/d through the pressure distillation process, 45,000 bbl/d through heavy fuel desulfurization, 400 tons per day of sulfur, and 1.6 million cubic meters per day of hydrogen. In addition, Kijushu Oil has allocated $214 million for new construction and expansion at its Oita plant to be completed by 1976.

Other firms with expansion scheduled for completion in the 1976-77 period include Kashima Oil,

Table 2.—Japan: Estimated imports of selected process control instruments by country of origin
(in thousands of U.S. dollars)

	1970	1971	1972
Electric/electronic industrial process pressure instruments			
United States	200	300	338
United Kingdom	19	10	12
Germany	5	4	2
Other	10	3	2
Total	234	317	354
Electric/electronic industrial process flow and liquid level instruments			
United States	877	700	708
United Kingdom	30	50	30
Germany	0	13	13
Sweden	3	1	3
Other	4	2	2
Total	914	766	756
Electric/electronic industrial process control gas and liquid analyzers on-stream instruments			
United States	1,069	1,100	1,310
Sweden	35	68	150
United Kingdom	4	9	8
Other	10	15	15
Total	1,118	1,192	1,483
Nonelectric/nonelectronic industrial process control instruments			
United States	3,231	3,300	3,317
Germany	123	150	220
United Kingdom	86	91	99
Denmark	30	35	40
Other	70	66	50
Total	3,540	3,642	3,726
Valves for industrial process controls			
United States	5,900	5,900	6,100
Germany	525	430	608
United Kingdom	277	244	248
Denmark	300	272	280
Other	481	481	656
Total	7,483	7,327	7,892

Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Japanese trade source estimates.

Taiyo Oil, Tao Nenrys, and Tohoku Oil. Most new installations will require one closed process control loop for every 50 to 60 bbl/d of refinery capacity.

The Government has adopted a program to strengthen the Japanese-owned oil companies. The Government probably will give preference to these domestic companies in their requests to build or expand refining facilities and will provide aid in obtaining loans from the Development Bank of Japan.

Instrumentation with high sales potential in the oil refineries sector includes:

- On-line gas and liquid chromatographs
- Thermal analysis apparatus
- In-line digital blenders
- Automatic line-up sequence systems for blending
- Safety valves
- Man-machine communication systems, including chart display devices, character display devices and process operators console systems

An example of an advanced instrumentation system used in controlling refining in Japan is found in the Negishi Oil Refinery in Yokohama. The installation, owned by Nippon Petroleum Refining Co., is the largest oil refining plant in Japan, with capacity of 330,000 bbl/d. All processes in the plant are controlled by the following four central systems:

- Fuel oil integrated system for the Negishi area is centered on an ordinary pressure distillation system. Six systems are integrated with 120 loops.
- Integrated system for high quality lubricating oil production which is centered on the diminished pressure distillation system: 5 systems are integrated with 240 loops.
- Fuel oil integrated system for Honmoku Area I which is centered on two ordinary pressure distillation systems, with an estimated 11 integrated systems and 300 loops.
- Fuel oil integrated system for Honmoku Area II which is centered on an ordinary pressure distillation system, with 8 integrated systems and an estimated 250 loops.

The longest transmitting distance from the local instruments to the control room in this plant is about 700 meters in one integrated system. The longest transmitting distance among different integrated systems is also about 700 meters. Thus, after a 3-year test period, the plant purchased electronic instrumentation instead of pneumatic.

By adopting integrated control systems, the number of instruments which normally would be monitored by operators was increased. Consequently, data loggers are now being used for all integrated systems in order to decrease the operators' responsibility and reduce the total number of personnel.

The plant has adopted on-line analyzers as much as possible, e.g., first-point analyzers, end-point analyzers, viscosimeters, sulfur analyzers, gas chromatographs, moisture meters, density meters, and oxygen analyzers. The plant has 6,300 instruments, categorized as follows:

- Differential flowmeters, 1,234
- Mass flowmeters, 415
- Turbine-type flowmeters, 27
- Pressure indicators, 911

Table 3.—Japan: The largest manufacturers of process control instruments, ranked by sales, 1973
(in millions of U.S. dollars)

Company	Estimated sales of measuring and process control instruments [1]	Foreign affiliates
Yokogawa Electric Works, Ltd.	149	Hewlett-Packard (U.S.)[2]
Yamatake-Honeywell Co., Ltd.	95	Honeywell (U.S.)[1]
Tokyo Shibaura Electric Co., Ltd.	91	Beckman Instrument (U.S.)[2]
Shimadzu Seisakusho, Ltd.	78	Hartmann & Braun (Germany) Nuclear Chicago (U.S.) Commonwealth Scientific & Industrial Research Org. (Australia) LKB Instruments (U.S.) Applied Research Laboratories (U.S.) Bausch & Lomb (U.S.)
Hitachi, Ltd.	75	Ebasco Services (U.S.) Perkin Elmer (U.S.) RCA (U.S.) Gilford Instruments Laboratories (U.S.)
Fuji Electric Co., Ltd.	70	Siemens (Germany)
Hokushin Electric Works, Ltd.	52	Mine Safety Appliance (U.S.)[2] General Electric (U.S.)

[1] Includes some analytical and scientific instruments.
[2] Company names followed by footnote indicate joint ventures. Remaining firms have established licensing agreements for the production of process control instrumentation.
Source: Data based on financial reports obtained from the Japanese Ministry of Finance.

Table 4.—Japan: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Sales 1972	Capital investment 1972	Process control instrumentation consumption 1972	1978
Primary metals	29,629	2,470	32.7	82.7
Food processing	24,351	359	5.6	11.0
Chemical processing	16,584	1,048	62.6	154.4
Petroleum refining	10,208	1,165	43.2	107.6
Stone, clay, and glass	8,818	382	4.7	11.0
Paper and paper products	7,760	398	7.5	14.9
Electricity generation	7,662	3,256	35.0	82.7
Instruments	697	29	2.3	5.5
Liquefied natural gas	77	4	1.2	5.5
Pipelines services	2	NA	.2	5.5

Source: Bureau of International Commerce, Office of International Marketing research study.

- Tank gages, 273
- Level meters, 622
- Thermometers, 405
- On-line analyzers, 150
- Weighing and capacitance meters, 32
- Regulator valves, 2,231

Electricity generation and distribution sector.—Improvements in Japanese living standards have brought increased demand for electric power. Japan has nine electric power companies, each with a monopoly in its particular geographical division. The 32 local municipal governments have their own electric power generating plants which supply nine power companies. Another power supplier is the Japan Electric Power Development Co., a Government-capitalized firm, which also develops hydraulic power resources. In 1975 these groups jointly established the Japan Atomic Power Co., which is now building atomic power plants.

The electric power companies employ 136,459 persons. The three largest firms—Tokyo, Kansai, and Chubu—have 76,991 employees, or 56.4% of the work force, and produce 64.9% of the power. The nine regional companies have approximately 75% of the generating capacity. Their sales volume amounted to almost $2.5 billion in 1965 and increased in 7 years to a total of almost $6.5 billion, an average annual growth of 14.5%.

The electric power generating sector invests more in plant and equipment than any other Japanese sector. In 1973 a total of $1.5 billion was invested, 55% more than in 1972. An estimated $6.2 billion was to be invested in 1974.

Electric power generating capacity is expected to develop at an average annual rate of 15%, rising from 74 million kilowatts (kW) in 1974 to 169 million kW in 1979. In March 1974, 70.6% of electricity generating capacity was based on thermal power, 26% on hydro power, and 3.4% on nuclear energy. In 1979, only 60% should come from thermal power, 19% from hydro power, and 21% from nuclear sources. Capacity of thermal power plants is expected to expand from almost 53 million kW in 1974 to over 100 million kW in 1979. The Chubu Power Company plans to expand thermal generating capacity in two of its plants by 2.1 million kW, at a cost of $253 million. These plants, scheduled for completion in 1976, are expected to contain 180 closed loops. The Tokyo Power Company has allocated $124 million for expansion at its Fuji installation. The new facility, with a generating capacity of 700,000 kW, will utilize 120 closed loops. The Tohoku, Hokuriku, Kansai, Chugoku, and Kyushu power companies also plan major expansion programs. These seven firms are expected to spend $1.4 billion to increase capacity by 9.2 million kW between 1975 and 1977.

The Government intends to place greater emphasis on nuclear power as a source for electricity in order to reduce production costs. Nuclear-based generating capacity is expected to rise from 2.5 million kW in 1974 to almost 36 million kW in 1979, then reaching approximately 60 million kW in 1980. Although a question regarding the safety of nuclear plants and a lingering distaste for atomic power have delayed development, the Japanese Government and electric power companies have taken a more positive attitude toward nuclear power generation in the wake of the oil crisis. The latest available data show only six reactors, but MITI has approved construction plans for another 17 reactors, which will add over 14 million kW to capacity. The Government organized a group known as the Power Reactor and Nuclear Fuel Development Co. that is subsidized by both national funds and the electric power companies. This company since 1967 has developed an advanced thermal reactor and a fast-breeder reactor, and prototypes of each are under construction.

All nuclear power plants in Japan, except one, are based on U.S. technologies. There are three BWR types, two PWR types, and the lone Calder

Table 5.—Japan: Number of establishments by industry and employment size

Industry	No. of establishments		
	Large (500 or more employees)	Medium (20 to 499 employees)	Small (1 to 19 employees)
Food processing	119	8,865	79,122
Paper and paper products	68	2,916	14,238
Chemical processing	199	2,319	3,434
Petroleum	23	226	469
Stone, clay, and glass	86	5,287	24,395
Primary metals	133	2,686	4,800
Electric measuring instruments	7	82	264

Source: Bureau of International Commerce, Office of International Marketing research study.

Hall (United Kingdom) type now in operation. Of the 17 plants approved for use, 10 BWR reactors manufactured by General Electric and 7 PWR reactors sold by Westinghouse are to be installed in the near future. The control systems, therefore, will be the same as those used in the United States. Partial information available on present and planned nuclear power plant construction indicates that more than 1,240 closed loops will be used.

Japan's electrical energy sector will likely look to U.S. suppliers for the following instruments:

- Neutron instrumentation systems
- Isolation valves and safety valves for emergency shutdown
- Pressure rating isolation and safety valves
- Leakage detectors, especially for radioactive material
- Detectors to prevent leak hazards
- Panel meters
- Seismic analyzing equipment

Japan's thermal and hydro power plants use technology derived largely from licensing agreements with United States, German, or Swiss companies. Thus, they manufacture steam turbines under agreement with International General Electric and steam boilers under Westinghouse Electric International. Canadian Westinghouse has provided technologies for generators and voltage regulators.

The Yokohama Thermal Power Plant of the Tokyo Electric Power Co. was the first plant in Japan to specialize in non-pollutant liquid natural gas (LNG) combustion for generating thermal power. This plant has a generating capacity of 1,150 megawatts (MW) from two 350-MW generators and one 450-MW generator. It has automatic boiler control, combustion control, auxiliary equipment control, and turbine starter systems as well as an alarm switch instrumentation system, instrumentation supervisory system, computing system, air conditioning system, and power source system for control equipment.

Blast furnaces and basic steel mills sector.—The largest sector in the primary metals industry is the blast furnaces and basic steel mills sector. This sector employed 255,000 people out of a 567,000 total for the entire industry in 1972. Industry sales reached $27 billion in 1972, when capital investment amounted to $2.5 billion. Trade sources estimate purchases of process control instrumentation by the industry to have totaled almost $33 million in the same year. Sales to the industry are expected by 1978 to amount to almost $83 million.

Japan is one of the world's largest producers of steel. The blast furnaces and basic steel mills sector produced almost 103 million metric tons (MT) of crude steel, over 105,000 MT of hot-rolled steel, and almost 78,000 MT of pig iron in 1972. Crude steel production had jumped to 120 million MT by 1973.

In 1972 there were 27 blast furnaces and basic steel mills in Japan. One plant, Nippon Steel, employed over 50,000 persons, and four others, Nippon Kokan, Kawasaki Steel, Sumitomo Metal, and Kobe Steel, each employed over 30,000 persons. Nippon Steel led the eight integrated iron and steel manufacturers in 1972, accounting for 43.9% of the pig iron production and 34.3% of the crude steel output. The top six companies produced 98.3% of the pig iron and 80.5% of the crude steel. None of the firms are subsidiaries of foreign companies.

The recent investment picture reflects the tight monetary and investment policy maintained by the Government to curb inflation. Overall investment by the steel companies in plant and equipment fell off slightly from $2.3 billion in 1971 to about $2.1 billion in 1973. Of six blast furnaces approved in 1971, four went into production in November 1973, and construction began on two more. The latter are due to be completed by March 1976.

Crude steel capacity was only 130 million MT in 1974, and the industry predicted that 145 million MT will be required in 1977 and 160 million in 1980. The sector has extensive investment plans to satisfy rising demand. Nippon Steel plans to spend almost $220 million between 1974 and 1976 for the construction of three blast furnaces and a sintering mill. The firm has another sintering mill planned for completion in 1975 that will contain 280 closed process control loops. A blast furnace and a converter, in addition to cogging, continuous casting, pellet, and plate mills, will be built at a cost of $1.4 billion by Nippon Kokan at Ogishima. The project will be completed in 1976. The converter will require 300 closed loops, the plate mill 350, and the cogging mill 260.

For planned facilities and processes, the following instruments or systems probably will be required:

- CRT display devices for man-machine interface
- Process gas chromatographs, especially multisample gas chromatographs for continuous monitoring
- Electronic weight detectors
- Testing equipment to detect oil stain, contamination, patterns, or blemishes on fast-moving steel strips
- Package burning control system
- Safety and isolation valves

Nippon Steel Co., Ltd., in its Kimitsu Mill, has developed a continuous annealing and processing line and a system of direct rolling of slabs from a cogging mill, involving the use of totally computerized controls in a modern hierarchy system. Kimitsu also has an on-line system for all production processes, inventory control, and shipping.

Some 30 computer display terminals and printers are located in Kimitsu's thick plate rolling mill, which has about 180 closed loops and can produce 1.4 million MT of thick plate per annum. The control system was designed by the Japan Steel Company, a merger of the former Yawata Fuji Steel Companies, but it is built around two IBM-370 CPU's, supported by seven Japanese computers believed to include some of the Fujitsu's FACOM series. IBM coordinated the design and installation.

Industrial organic chemicals sector.—The chemical processing industry, with a capital investment of just over $1 billion in 1972, had $16.5 billion in sales. It accounted for almost 27% of the process control instrumentation market and is expected to absorb a slightly larger share by 1978. Particularly important control instrument markets are found in the organic chemicals manufacturing and plastics and synthetics manufacturing sectors, but agricultural chemicals and inorganic chemicals also offer good markets.

Japanese companies engaged in organic chemicals manufacturing number approximately 1,000, with a total of 130,000 employees. There are 145 petrochemical and derivative manufacturing companies with an aggregate 60,000 employees; the largest manufacturers employ 31,000 workers. The most important products in this sector are ethylene and derivatives.

The value of petrochemical production in 1972 amounted to $4.3 billion, having grown at an average annual rate of almost 19% from 1967 to 1972. Major components of this output were $831 million of propylene, butadiene, and ethylene; $378 million of synthetic rubber; $376 million of polystyrene; and $214 million of polypropylene. Although there are 19 joint ventures, 15 of which are in partnership with U.S. manufacturers, the Japanese-owned firms are the major manufacturers in this sector.

Investment in plant and equipment in 1973 amounted to $534 million. Since an important key to the future is effective process control, the sector will be seeking the best possible instrumentation.

Table 6.—Japan: Output of petroleum products, 1971 and 1972

	Unit	1971	1972
Gasoline	Millions of bbl	152.6	155.4
Naphtha	millions of bbl	157.0	169.3
Jet fuel	millions of bbl	16.9	21.3
Kerosene	millions of bbl	110.5	106.8
Light fuel	millions of bbl	83.3	91.1
Heavy fuels	millions of bbl	720.9	746.5
Lubricating oil	millions of bbl	15.3	15.4
LPG	thousands of MT	3,708.0	3,946.0
Paraffin	thousands of MT	146.0	152.0
Asphalt	thousands of MT	4,175.0	4,578.0

Source: Bureau of International Commerce, Office of International Marketing research study.

With ethylene demand forecast at 5.5 million MT in 1977 and production in 1972 at a level of only 4.8 million MT (see table 7), MITI has approved four additional plants with a combined capacity of 1.5 million MT per year. Construction of these plants will entail installation of some 260 closed loops. Production plans for a variety of other petrochemical facilities indicate installation of at least 765 more closed loops in the 1974-77 period.

Instruments or systems with a high sales potential in the sector will include the following:

- Semiconductor detectors for industrial gas analysis
- Liquid density meters for on-stream use
- Petroleum sulfur meters, needed for on-line blending
- On-line atomic absorption analyzers
- Liquid chromatographs for on-stream use

The Japanese petrochemical industry is on a par with similar industries throughout the world because it relies on foreign technology, particularly American. For example, Japanese polyethylene producers rely upon Union Carbide, DuPont, Dow Chemical, and Gulf for their processing technology. Ethylene producers in Japan use technology developed by

Table 7.—Japan: MITI demand forecast for ethylene and downstream products, 1974-77

(in thousands of metric tons)

Product	1974	1977
High-pressure polyethylene	1,216	1,400
Medium and low-pressure polyethylene	600	833
Ethylene oxide	449	602
Styrene monomer	364	476
Acetaldehyde	452	528
Vinyl chloride monomer	824	986
Subtotal	3,905	4,825
Other derivatives	414	581
Other products	100	50
Total	4,419	5,456

Source: Official Japanese Ministry of International Trade and Industry statistics.

Esso and Stone and Webster, among others. Kashima Vinyl Chloride Monomer Co. plans the construction of a caustic soda factory using the mercury electrolysis method of the Diamond Shamrock Chemical Co. of Cleveland, Ohio. A methanol plant to incorporate Imperial Chemical Industry's low-pressure method for the composition process is in the offing for the Kashima Methanol Company.

The polybutadiene plant of the Chiba Petrochemical Plant, Ube Industries Co., is a good example of the type of control system used in the Japanese petrochemical industry. Productive capacity is 25,000 MT of polybutadiene per year. In its production process, this plant adopted a direct digital control system which controls roughly one-third of its 120 loops. Major processes under direct digital control are material mixture, temperature and ratio control of polymerization, cascade and ratio control of separation, and distillation control of recoveries.

Duties and Trade Regulations

The import tariff rate is 7% on the c.i.f. value of almost all imported instruments. There are quota controls on importation of computers, but a considerable number of U.S. computers are manufactured in Japan. There are no special labeling requirements for process control instrumentation in Japan.

Japan uses the metric system of weights and measures exclusively. Additional information on Japanese technical standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Japan to supplement this report is available on a continuing basis from:

Country Marketing Manager
Office of International Marketing—Japan
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-2427

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

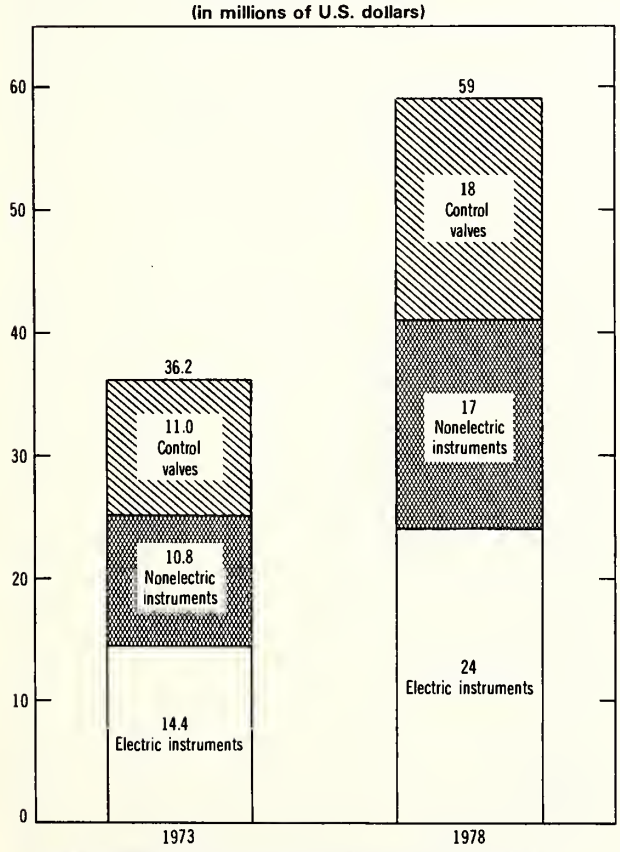
Please request: "The Market for Process Control Instrumentation in Japan", DIB 74-10-512, June 1974.

The Office of Export Development also has available for $3.00 a "Target Market Trade List: Process Control Instrumentation—Japan" which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

Mexico

The Mexican market for process control instrumentation has been growing at a rapid, steady pace, going from $22 million in 1970 to over $36 million in 1973 (see table 1). The 1978 market is projected at almost $59 million, representing a 10% annual growth rate over the 1973 level. The United States is expected to remain the major supplier to this expanding market by a wide margin. Growth in the petroleum industry and in electricity generation and distribution should assure good sales opportunities for process control instrumentation in these industries. Substantial expansion plans are reported by two Government-owned industries which in 1972 accounted for over 40% of the process control instrument market—Petroleos Mexicanos (Pemex), the petroleum, natural gas liquids, and pipeline service company, and Commision Federal de Electricidad (CFE), the State-owned electric power firm. Pemex reports that it expects to invest $2.7 billion in the 1974-76 period for refinery expansion and new petrochemical plants. This firm accounted for nearly one-third of estimated consumption of process control instruments in 1972. CFE plans to add 6.45 million kilowatts (kW) of generating capacity by 1976.

Mexico: Size of market for process control instrumentation, 1973 and projected 1978



Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Mexican trade source estimates.

There is a growing trend in Mexico toward greater use of *electric/electronic instruments,* especially because of the explosion retardent designs now available. Sales of electronic instruments consequently are projected to expand from $14.4 million in 1973 to $24 million in 1978, reflecting an average growth of almost 11% a year. Sales of *nonelectric/nonelectronic instruments* are forecast to grow at a slower pace, 9.5% a year, during the same period. Purchases are expected to total over $17 million in 1978. The market for automatic control valves should grow by 10.3% annually—from $11 million in 1973 to almost $18 million in 1978.

U.S. market position strong.—Imports, valued at $30 million in 1973, accounted for 83% of the total market for process control instruments. U.S. sales accounted for 74% ($22.4 million) of imports in that year. By 1978, imports are expected to reach nearly $38 million, with 75% of this coming from the United States (see table 2).

U.S. manufacturers are expected to maintain their share of the import market largely because of their

Mexico—Selected Indicators
(1973)

Gross domestic product:	**$49.5 billion**
Population:	**54.3 million**
Total country imports:	**$3.84 billion**
Total country exports:	**$2.08 billion**
Exchange rate (Dec. 1974):	**12.5 pesos=US$1**

growing success in selling electronic instruments. Imports from the United States of electric instruments are forecast to rise nearly 60%, from $10.8 million in 1973 to over $17 million in 1978. U.S. sales of automatic control valves to Mexico will probably show a small gain—from $5.9 million to about $6.8 million. A slight decline from $5.6 million to approximately $4.4 million is projected for the nonelectronic group.

In addition to imports, U.S. manufacturers supply the market through their subsidiaries and licensees located in Mexico. Major subsidiaries include Honeywell S.A. de C.V., which sells instruments for indicating, recording, and controlling temperature, pressure and flow; Foxboro, S.A., handling pneumatic instrumentation for recording, transmitting, controlling and indicating; Fischer & Porter, S.A., marketing rotometers, chlorators, and equipment for measuring liquid flow; and Leeds & Northrup Mexicana, S.A., providing pneumatic instruments.

Foreign firms offer competition.—The bulk of process control instruments used in Mexico comes from foreign suppliers. Domestic production in 1973 was only one-fifth of total sales, and nearly all of that was provided by subsidiaries of U.S. manufacturers.

Among the more important of the third-country suppliers are Siemens and Hartmann & Braun of Germany, and George Kent of England, although Europe and Japan generally trail far behind the United States in sales. When processing methods are based on patents from European firms, instruments are generally imported from the same country. For instance, Vidrio Plano Mexico, S.A. usually buys British instruments because they are using a Pilkington Brother Ltd. (United Kingdom) process in the manufacture of floated crystal.

According to trade sources, English-made density transmitters are often preferred by Mexican end-users because of their excellent safety features. German temperature controllers and recorders are also popular in Mexico.

Domestic production of process control instrumentation increased from almost $2 million in 1970 to over $7 million in 1973. Local manufacturers are expected to supply 38% of the market by 1978, with sales in that year exceeding $22 million. This rapid growth can be attributed partly to the Mexican Government programs and policies that support local production of process control instruments. Import barriers are designed to protect local manufacture and assembly of instruments in Mexico. The National Content program requires the use of some Mexican-made parts, even if they are more expensive than those available from the United States. This policy is intended to encourage local production, regardless of the firm's nationality. As of late 1974 there were no Mexican-origin trademarks for process control instruments.

The main advantages of the Mexican-made products are shorter delivery times, greater availability of parts, and, in some cases, lower prices. Labor costs are, of course, lower than those in the United States. On the other hand, Mexican raw materials are sometimes more expensive and of lower quality than those of the United States, a situation that favors assembly over manufacture of the finished product.

The Mexican Government has several plans for stimulating exports of process control instruments, principally to Central and South American markets. Partial refunds of taxes are available to manufacturers for products made in national plants and then exported. Financial aids include: payments for part of the total direct costs of production and inventory maintenance; credit for export sales; and protection

Table 1.—Mexico: Size of market for process control instrumentation, 1970, 1972-73
(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	—	—	—
Imports	10.0	10.0	14.4
Exports	—	—	—
Market size [1]	10.0	10.0	14.4
Nonelectric/nonelectronic instruments			
Production	1.1	2.8	4.0
Imports	6.1	5.9	7.4
Exports	.6	.9	.6
Market size	6.6	7.8	10.8
Automatic control valves			
Production	.6	1.4	3.3
Imports	5.2	6.6	8.1
Exports	.4	.4	.4
Market size	5.4	7.6	11.0
Total process control instrumentation			
Exports	1.7	4.2	7.3
Production	21.3	22.5	29.9
Imports	1.0	1.3	1.0
Market size	22.0	25.4	36.2

[1] Market size equals production plus imports minus exports.
Source: Bureau of International Commerce, Office of International Marketing research study.

against losses caused by foreign political instability. Exports, although small in relation to the market, are projected to increase from a little over $1 million in both 1970 and 1973 to $1.7 million in 1978.

Major Industrial Users

A market survey recently conducted for the U.S. Department of Commerce, Office of International Marketing revealed that 10 major industries are the primary purchasers of process control instrumentation (see table 3). Between 1972 and 1978, instrument sales to these industries are expected to expand from $29.5 million to almost $45 million. Their output in 1970 was valued at $4.4 billion. The petroleum, utility services and primary metals industries offer particularly good sales opportunities to U.S. manufacturers of process control instrumentation.

Petroleum industry.—Pemex, a government-owned enterprise, is responsible for the processing of crude oil and the manufacture of miscellaneous petroleum products. The enterprise employed 78,000 workers. Output of petroleum refineries reached almost 198 million barrels (bbl), and production of miscellaneous petroleum products exceeded 23 metric tons (M.T.).

Stepped-up investments are necessary if domestic petroleum refining is to keep pace with the estimated 12%-14% annual increase in demand in the coming years. Pemex will require an average increase of 1 billion bbl a year of new hydrocarbon reserves, or for more than the 35.5-million-bbl annual increase in the 1965-72 period. Official estimates are that by 1976 Mexico's demand for petroleum will amount to 835,000 barrels per day (bbl/d), a 60% increase over the 525,000 bbl/d needed in 1972.

A major project now under construction is a new refinery at Tula, estimated to cost $292 million, excluding land acquisition and development costs. The first stage, to be finished by 1976, will have a capacity of 150,000 bbl/d, representing 17.7% of total production of the industry. The second stage will have the same capacity as the first. Investment for the first stage is estimated at $168 million, of which equipment costs are to be $74 million. The plants being built at Tula in the first stage include a catalytic disintegrator, a hydro desulfurator, a hydro desulfurator and naphtha processor, and a viscosity reducer. These plants will produce gasolines, diesel fuel, kerosene and turbosine, liquefied petroleum gas (LPG), and sulfur.

The Mexican petroleum industry uses advanced technologies such as catalytic cracking, hydrogenation of residual product, and thermal disintegration in primary distilling plants. New plants have been installing electronic analog instruments and long-range plans call for use of computer systems.

Table 2.—Mexico: Imports of selected process control instruments by country of origin
(in thousands of U.S. dollars)

	1970	1971	1972
Automatic valves			
United States	1,584.0	1,433.8	1,879.8
Germany	341.0	97.5	65.2
Canada	—	—	131.8
Other	221.2	226.2	206.2
Total	2,146.2	1,757.5	2,283.0
Hydraulic control valves			
United States	349.0	326.0	401.1
Germany	13.0	16.1	17.6
France	—	9.5	44.4
Other	8.6	11.3	27.2
Total	370.6	362.9	490.3
Automatic thermostats for water temperature control	708.4	799.4	1,325.0
United States	1.8	2.1	0.7
Other	—	—	—
Total	710.2	801.5	1,325.7

Source: Official Mexican statistics.

New plants such as the one at Tula have a few systems supervised by computer. However, installation of this type of instrumentation is being slowed by (1) opposition from labor unions because of the implicit reduction of labor, and (2) the shortage of skilled workers.

The research revealed that temperature and level indicators in new plants are of the digital type. Although on-stream analyzers are currently in use, in the future they will be utilized mainly in delicate processes. Ultrasonic level indicators also are employed.

Pemex is composed of both old and modern plants built up over a long period and under a variety of policies. Consequently, many different process control instruments and systems are in use. Instrumentation within a given plant may range from simple pneumatic devices to the most advanced and sophisticated equipment available.

The system used in the regenerator reactor section of one catalytic cracking plant contains 55 closed loops and one on-stream oxygen analyzer. Most instrumentation is of the analog type. Measurements of temperature, flow, and pressure, as well as of combustion gases, are monitored from the control room. The system also has a protective device for the regenerator reactor which isolates the reactor, controls the feeding of material, and maintains the proper temperature during production.

Electricity generation and distribution.—More than 95% of Mexico's electricity is generated by the Government-owned CFE and its affiliate, Cia. Luz y Fuerza del Centro, S.A. CFE operates 197

Table 3.—Mexico: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Value of production 1970	Process control instrumentation consumption 1972	1978
Food processing	1,441.2	0.9	1.7
Paper and paper products	190.4	1.1	2.0
Chemical processing	441.4	2.6	5.2
Petroleum [1]	1,061.6	8.3	19.8
Stone, clay, and glass	386.0	2.0	4.0
Primary metals	409.6	1.8	5.4
Utility services	494.5	2.8	6.6

Source: Based on the *Annual Report*, Bank of Mexico, 1972; and the Bureau of International Commerce, Office of International Marketing research study.
[1] Includes the natural gas liquids and pipeline services industries.

plants—82 hydroelectric, 33 thermal, and 82 internal combustion—and in 1972 employed 32,238 full-time workers. Generation of electric power in 1972 reached a record of nearly 35 billion kWh, up 11.2% from the preceding year, and sales amounted to almost $374 million.

Overall development costs for the 1973-76 period are estimated at nearly $1.4 billion, with at least 60% earmarked for additional generation facilities, transmission lines, and substations. New projects to be undertaken include the construction or expansion of hydroelectric plants, intended to increase capacity by 3,000 megawatts (MW), steam turbine plants (3,900MW), gas turbine plants (500MW), and a nuclear power plant (660,000 kW). In addition, over 11,000 kilometers of transmission lines will be strung and about 17,000 substations are scheduled for completion by 1976.

Mexico's first nuclear power plant is scheduled to be completed in 1977 at Laguna Verde, Vera Cruz, at a cost of $160 million. Generating capacity will be 660,000 kW of electricity. General Electric is constructing and installing the plant's nuclear reactor. Two Japanese companies—Mitsubishi Heavy Industries Ltd. and Mitsubishi Electric—will supply the turbogenerator.

A geothermic energy plant at Cerro Prieto near Mexicali will be the first to operate in Mexico on a commercial basis. The plant, with a generating capacity of 75,000 kW, represents an investment of $220 million.

A cycle changeover—from 50 to 60—is underway in the Federal District area. This project is scheduled to be completed by 1979 at an estimated cost of $176 million. Two new generators at Infiernillo will boost output from 672,000 kW to over 1 million kW.

Generating capacity in the Monterrey metropolitan area was scheduled to be increased 150% by 1975, requiring an investment of $80 million. The first part of this improvement was the establishment of two new generating units with a combined capacity of 168,000 kW.

The mammoth hydroelectric project under construction on the Santiago River in Nayarit is scheduled for completion by 1976. The $58 million plant will have a capacity of 540,000 kilowatts.

Demand over the next 5 years is expected to be strongest for analog, pneumatic, and electronic instruments. Most of the process control instrumentation in Mexico's electric utility industry is in thermoelectrical plants or in the new nuclear-powered plant.

Differences among the systems used in the various thermal plants are slight. A typical control system used in one plant for supplying water to the steam generator has three closed loops (water, steam pressure, and level control). The level-control loop has a subloop for temperature compensation. All the instruments are of the analog type, and there are no on-stream analyzers.

The following equipment is in the control room: Level, steam, and water flow recorders; a manual/automatic controller station; a water flow integrator; temperature and pressure indicators, recorders and indicators for a generator drum's pressure and water level. Turbine and generator tubes are protected against too high or too low a water level in the drum.

Blast furnaces and basic steel mills sector.—Mexico's steel production in 1972 totaled 4.4 million MT. Seven of the 18 enterprises producing steel accounted for 94% of the total tonnage and employed over 10,000 of the 14,000 workers in 1970. All of the steel was produced by Mexican-owned firms.

A Government intersecretarial commission established in 1972 regulates and plans expansion of the industry. The program called for doubling investment by 1980 to satisfy anticipated steel require-

Table 4.—Mexico: Number of establishments by industry and value of production, 1970

Industry	Large (more than $80 million)	Medium ($2.8 million to $80 million)	Small (less than $2.8 million)
Food processing	66	149	38,741
Paper and paper products	15	38	564
Chemical processing	45	128	2,622
Petroleum [1]	1	5	61
Stone, clay, and glass	14	31	3,565
Primary metals	34	35	259
Utility services	4	—	—

Source: Based on *Avance al Resumen General del IX Censo Industrial 1971 Datos de 1970.*
[1] Includes the natural gas liquids and pipeline services industries.

ments. Mexico is expected to be completely self-sufficient in steel production by 1976, when capacity will be 8.5 million MT of ingots and 7.5 million MT of finished steel products. These figures will exceed the projected national demand for that year of 6 million MT and 5.2 million MT, respectively.

A major development in 1976 will be the completion of Phase One of the massive Las Truchas steel complex. Located near iron ore deposits reported to be Mexico's largest, the complex will be operated by the State-owned Cia. Siderurgica Las Truchas, S.A., and will employ some 6,000 persons. The plant will be highly automated, being controlled by computers, and is expected to have more than 500 closed loops. Work on the second stage will start in 1977. Plans call for the plant to be producing 1.5 million MT of ingots per year by 1976 (18% of the national total) and 2.5 million MT by 1980. Some 25% to 30% of total production is projected for export.

Also underway is an expansion program by Fundidora Monterrey, S.A., the nation's oldest steel company and largest privately owned corporation. Ingot steel capacity is to be increased from 900,000 MT in 1972 to 1.5 million by late 1975. The company's fourth new blast furnace is to be installed, and capacity for cold-rolled steel products is to be doubled.

Mexico's largest steel producer, Altos Hornos de Mexico, S.A., which accounted for 41% of total ingot production in 1972, has announced that it will invest $160 million by 1976. Production capacity will be increased to 4 million tons a year, compared with 2.5 million estimated for 1973. The company also plans to build new plants for producing special steels, machine-grade steels, and similar products.

Mexico's steel industry also is making investments to reduce atmospheric contaminations under a law that went into effect in 1972. By 1974, smokestack emissions for most companies were to be reduced 6 to 10 times from earlier levels.

The most advanced techniques available are planned both for new plants and for the expansion of facilities. An on-stream computer will control the blast furnaces in the Las Truchas complex. The plant's basic oxygen furnace (BOF) also will have a computer to calculate charge and data logging of the plant. A computer is to monitor the energy supply. Fluorescence and spectrographic equipment will be used for analyzing materials, and mass spectrometers will analyze top gas in the blast furnace.

The following instruments and systems are expected to be in good demand in this sector over the next 5 years: Electronic, mainly analog to digital, converters; pneumatic instrumentation for the final actuators; special electronic weighing systems; and level measurement instruments. The planned automatic control systems also call for increasing use of on-stream anaylzers.

The techniques to be used at the Las Truchas plant will serve as a pattern for future expansion by other steel companies. The plant will have 12 areas, each with its own conventional instrumentation. In addition, there are three process computer systems—one on the BOF, one on the blast furnace, and one on the energy control center.

In the BOF plant area, the furnace is of the closed type, in which carbon percentage in the pig iron is controlled. The following activities are carried out by the system: Weighing and analyzing of materials feeding into the converter (scrap steel, pig iron, and additional materials such as ferroalloys, pellets, weighing compounds, and coolants); measuring and analyzing oxygen flow; and positioning the converter and nozzle.

There are approximately 100 closed loops for the two converters. There is one main analyzer for each converter, paramagnetic and infrared. Each main analyzer consists of four analyzers. Most of the instrumentation is analog. Taylor and Leeds & Northrup are the main suppliers. Supervisory and control operations are carried out in the control room. Position and temperature of the converter and nozzle also are set from the control room.

Duties and Trade Regulations

Import duties for the great majority of process control instruments range between 5% and 20%.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Mexico to supplement this report is available on a continuing basis from:

Country Marketing Manager
Office of International Marketing—Mexico
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: (202) 967-5020

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in Mexico," DIB 74-10-500, March 1974. The Office of Export Development also has available for $3.00 a "Target Market Trade List: Process Control Instrumentation—Mexico," which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

Main exceptions are rates of 100% for thermal devices. Imports of most instruments from member countries of LAFTA are either free or at low rates. Information concerning official duty rates may be obtained from the U.S. Department of Commerce, Room 4012, Main Commerce Building, Washington, D.C. 20230.

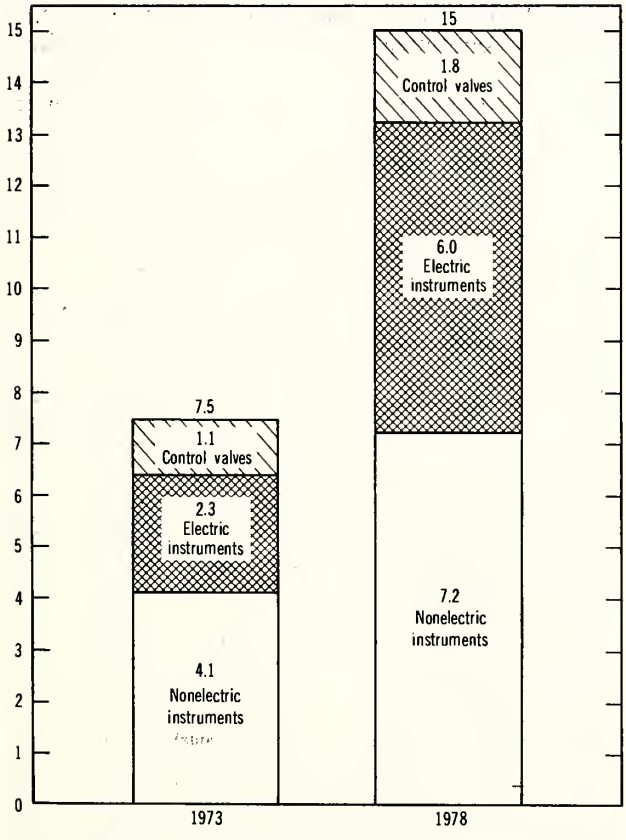
There are no special technical standards or labeling requirements for imports of process control instruments. However, they should conform to the conventional requirements for packaging and labeling. Appropriate documentation should be available from the supplier. Additional information on Mexico's standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Republic of China on Taiwan

The market for process control instrumentation in the Republic of China (R.O.C.) on Taiwan is growing at a strong pace. Sales between 1970 and 1973 grew at an average annual rate of 45%, over four times the growth rate of the gross national product. Total value of the process control instrumentation market amounted to $5.8 million in 1972 and reached $7.5 million in 1973 (see table 1). Sales, on the basis of planned expansions, should double by 1978. U.S. manufacturers are expected to supply about one-third of this market.

Taiwan: Size of Market for Process Control Instruments, 1973 and Projected 1978

(in millions of U.S. dollars)



Source: U.S. Department of Commerce, Bureau of International Commerce market research study. Values based on trade source estimates in Taiwan.

Total capital investments by the country's two largest process industries are projected to exceed $1 billion during the 1974-78 period. The petroleum industry, which now accounts for nearly 50% of the instrument market, has extensive developmental plans for its petrochemical sector. Major government participation and investments of over $500 million are expected within the next few years in the production of hydrocarbon materials. The government, through joint ventures with private firms, also plans to build over 40 facilities for the production of later-stage chemicals. This will cost an additional $500 million.

The government also is heavily involved in the utility services industry. Investments in thermal, hydro, and nuclear power projects already underway or planned for the next few years will total at least $2.3 billion.

Nonelectric/nonelectronic instruments, with sales of $4.1 million, accounted for the largest share of the market in 1973. This share, however, is expected to decline moderately by 1978. A faster rate of growth is anticipated in sales of *electric/electronic* instruments, which are forecast to increase over 21% annually between 1973 and 1978. While consumption of *automatic control valves* has been relatively small, it is expected to quadruple by 1978, approaching the $2 million level.

U.S. sales growing.—Imports were estimated to have supplied about 98% of the total 1974 market in Taiwan for process control instrumentation and are expected to hold approximately the same share in 1978. Control instrumentation imports amounted to $2.5 million in 1970 and had almost tripled to $7.4 million by 1973. Between 1973 and 1978, im-

Taiwan—Selected Indicators (1973)

Gross national product:	$9.4 billion
Population:	15.6 million
Total country imports:	$3.8 billion
Total country exports:	$4.5 billion
Exchange rate December 1974:	Fluctuating at about 38NT=US$1

ports are expected to increase at an average annual rate of 15%.

Imports of process control instruments from the United States rose at an estimated annual rate of 38% from 1970 through 1973. Sales by U.S. firms are expected to reach $4 million in 1978, representing a 27% share of total imports (see table 2).

Imports from the United States supplied 39% of the market for electronic instruments in 1972. U.S. firms are expected to maintain this share, with sales totaling almost $2.3 million in 1978.

Sales of American-made nonelectric instruments in that year are expected to climb to $1.3 million, representing an 18% share of the import market. U.S. suppliers doubled their sales of automatic valves from $156,000 in 1970 to $315,000 in 1973. American-made products are expected to satisfy over 25% of the demand in 1978. R.O.C. manufacturers generally believe that the entire range of U.S. process control instrumentation is of superior design and durable quality. U.S. products are considered to be especially advanced in the fields of electronic instrumentation and computer-controlled systems and are particularly favored for large process operations.

The competitive position held by U.S. manufacturers by virtue of their products' technological superiority may be enhanced by improving sales and service techniques. Service generally is not now as good as that of Japanese suppliers. Careful attention to correspondence, better supplies of spare parts, and reduced delivery times would make up for the geographic disadvantage. U.S. suppliers can benefit by showing a willingness to undertake special orders and custom work. It is also useful to approach consulting engineers who are responsible for setting out specifications of new industrial projects in Taiwan. Even engineering firms having offices or representatives in Taiwan, such as Badger, Fluor, Metcalf and Eddy, and Stone and Webster, often make their instrumentation decisions in the United States.

U.S. faces strong competition.—As a major supplier of process control instruments to Taiwan, Japan offers the keenest competition to the United States. On the other hand, since Japanese suppliers frequently are licensees of U.S. firms such as Foxboro and Honeywell, they are in fact making indirect sales for American corporations.

Japan has made a practice of tying sales to prospective loans. For example, when loans were extended to the Taiwan Sugar Company for expansion of its facilities, Japanese process control equipment was specified. Sizable purchases then were made from Yamatake-Honeywell.

Another advantage for Japanese suppliers is their proximity to Taiwan. Frequent visits by company representatives from Tokyo are occasions for both efficient servicing of old equipment and aggressive promotion of new instruments.

Major Japanese suppliers of process control instrumentation in the Taiwan market include Hokushin Electric Works, Ltd., Shimadzu Seisakusho, Ltd., Fuji Koki Manufacturing Co., Yokogawa Electric Works, Sakura Electric Co., Nagano Keiki Seisakusho, P. Gossen & Co. and Shinko Electronic Co. Ltd.

German firms such as Hartmann & Braun and Siemens AG also provide competition to U.S. firms. German process control equipment in the power plant and chemical fields has a good reputation, but similar U.S. equipment is considered comparable or better.

Although domestic capabilities are expanding, local manufacturers of process control instrumentation hold only 2% of the market. The present level of technical sophistication in Taiwan falls short of market requirements, which in most cases are met only by United States, European, and Japanese suppliers. The only major local producer is Yamatake-

Table 1.—Taiwan: Size of market for process control instrumentation, 1970, 1972, 1973
(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	—	.01	.03
Imports	.60	1.59	2.27
Market size [1]	.60	1.60	2.30
Nonelectric/nonelectronic instruments			
Production	—	.02	.08
Imports	1.50	3.28	4.02
Market size	1.50	3.30	4.10
Automatic control valves			
Production	—	.01	.01
Imports	.40	.89	1.09
Market size	.40	.90	1.10
Total process control instrumentation			
Production	—	.04	.12
Imports	2.50	5.76	7.38
Market size	2.50	5.80	7.50

[1] Since exports are negligible, market size equals production plus imports.

Source: Bureau of International Commerce market research study.

Table 2.—Taiwan: Estimated imports from the United States of process control instruments for selected years

(in thousands of U.S. dollars)

	1970	1972	1973	1974
Electric/electronic instruments	210	620	990	1,416
Nonelectric/nonelectronic instruments	510	1,088	975	968
Automatic control valves	156	296	315	369
Total	876	2,004	2,280	2,753

Source: Bureau of International Commerce market research study.

Honeywell, primarily involved in the assembly of parts imported from the United States and Japan to produce temperature, pressure, and flow indicating and recording control instruments. The Japanese firm, Shinko Electronic Co., Ltd., produces automatic temperature controllers, as does Chen Tai Enterprise Co., Ltd. Two other domestic firms, Chung Hsing Electric Co., Ltd. and Shin Lih Industrial Instruments Engineering Co., Ltd., manufacture control panels.

Prospects for future development appear favorable, provided that American or other overseas manufacturers either license technology or establish facilities in Taiwan. The potential for production of process control instrumentation already exists in an extensive electronics industry. The government encourages investment in high-technology industries such as electronics and instrumentation and gives tax benefits to both foreign and domestic investors in those fields.

Major Industrial Users

Demand for control instrumentation in Taiwan stems mainly from seven process industries. The petroleum industry, with two refineries having annual production valued at $200 million per year, is the leading consumer of control instrumentation (see table 3). In addition, coke, coal, and miscellaneous petroleum products accounted for yearly output of over $75 million. Demand for control instruments in the utilities services and chemical processing industries will probably grow at a faster pace than demand in the petroleum industry in the next few years. The primary metals industry, with iron and steel foundries accounting for most of the $158-million annual production, offers a new market for process control suppliers.

Petrochemicals sector.—Substantial growth already recorded in the output of petroleum products and chemicals is believed likely to continue. Between 1971 and 1972, the production of fuel oil by the government-owned Chinese Petroleum Corporation increased from about 2.8 to 4 million kiloliters (kl), of toluene from about 17,000 to 25,600 kl, and of benzene from 3,700 to 6,400 kl. Production of lube oil in the same year grew from approximately 41,400 to 52,000 kl and of base oil from nearly 85,900 to 95,700 kl, both manufactured by U.S.-R.O.C. joint-venture firms. Local and U.S.-R.O.C. joint-venture firms boosted methanol production from 46,900 to 58,800 MT, and polystyrene from 8,000 to 12,700 MT.

All production in this sector is presently accounted for by seven large enterprises. Capital investment is estimated at $150 million to $200 million per year and should maintain at least this level during the next 5 years. Consumption of crude oil in 1973 was 10 million barrels (bbl), and by 1976 this figure should reach 30 million bbl, primarily because of the expansion of petrochemicals.

The Chinese Petroleum Corporation plans to build a refinery and petrochemical complex near Kaohsiung which will be the largest in the country when completed in 1977. Other major projects include a 120,000 MT vinyl chloride monomer plant, a low density polythylene facility, and two styrene monomer plants (see table 4).

Process control instruments expected to be in demand in the petrochemicals sector include the following:

- Resistance and bimetallic temperature sensors and transducers
- Diaphragm pressure/vacuum sensors and transducers
- Flow orifices
- Flow rotameters
- Liquid level diaphragms
- Medium interface electric-to-pneumatic/pneumatic-to-electric converters
- Temperature, pressure, flow, and level force-balance transmitters (pneumatic and electronic)
- Temperature, pressure, flow, and level proportional plus reset electric and electropneumatic controllers
- Annunciators
- Temperature, pressure, flow, and level analog indicators

Table 3.—Taiwan: Consumption of process control instrumentation by major industries

(in thousands of U.S. dollars)

Industry	1972	1978
Natural gas liquids	60	150
Food processing	230	600
Paper and paper products	290	750
Chemical processing	1,160	3,750
Petroleum	2,800	5,550
Stone, clay, and glass	110	150
Primary metals	—	300
Utility services	1,160	3,750
Total	5,810	15,000

Source: Bureau of International Commerce market research study.

- Analog electrical panel meters
- Automated control globe valves
- Pneumatic valve actuators
- Pneumatic and electropneumatic valve positioners
- Self-contained direct actuated pressure valve regulators
- Pneumatic and electronic measuring and control systems

Electricity generation and distribution sector.—The electricity-generating sector, dominated by two large industrial establishments (see table 4), in 1972 comprised 28 hydroelectric plants with an installed capacity of over 900,000 kilowatts (kW) and light thermal power plants with total installed capacity of 2.6 million kW.

The government-owned Taiwan Power Company is the sole organization responsible for the development and supply of power. It has a number of new projects underway in the thermal, hydro, and nuclear power areas. Two 400-megawatt (MW) thermal power plants are planned in Taiwan for completion in April 1978 and December 1980, respectively, at a total cost of $138.4 million. A pumped-storage project planned for Sun Moon Lake will include seven 200-MW units costing $350 million total; the first of these is to be completed in December 1979.

The government's plans for nuclear power are extensive. The first project entails the construction of two 636-MW plants that are to begin operation in December 1975 and December 1976. A second project calls for two 850-MW stations to start in April 1978 and April 1979. Another two nuclear power plants, each with capacities ranging from 900 to 950-MW, are to be built at a total cost of $823 million at Kenting, with operations scheduled to begin in 1981 and 1982. Two additional plants, each with 1,300-MW capacity, are to be built at a total cost of over $1 billion; they are scheduled for completion at the end of 1984 and 1985.

Table 4.—Taiwan: Selected Petrochemical projects scheduled for completion by 1977

Company and Product(s)	Additional Capacity (in MT per year)
Asia Polymer Corp.	
low density polyethylene	100,000
United Polymer, Ltd.	
high density polyethylene	45,000
Lien Yu Industrial Co.	
high density polyethylene	50,000
Delta Consulting Engineers	
styrene monomer	100,000
Poly Chemical Co.	
styrene monomer	100,000
China Man-Made Fiber Corp. (United Nylon Corporation)	
ethylene gylcol; ethylene oxide	115,000
Union Carbide	
ethylene glycol; ethylene oxide	125,000
Shinkong Co., Ltd.	
ethylene glycol; ethylene oxide	50,000
Tong Chan Chemical Corp.	
acetaldehyde	55,000
Taiwan Acetaldehyde and Acetate Production Co.	
acetaldehyde	40,000
Tong Chan Chemical Corp.	
vinyl acetate	50,000
Taiwan Acetic Acid Polymer Co.	
vinyl acetate	30,000
Cathay Petrochemical Industry Co., Ltd.	
vinyl chloride monomer	120,000
Taiwan Plasticizer Corp.	
2-ethylhexanol	125,000
Taiwan Polypropylene Co.	
polypropylene	100,000
Tong Chan Chemical Corp.	
polypropylene	120,000
Li Shin Petrochemical Co.	
polypropylene	50,000
Chinese Petrochemical Development Corp.	
acrylonitrile	132,000
United Petrochemical Industries Co.	
alkyl benzene	30,000
Ho Yee Co.	
alkyl benzene	20,000
Chun Long Modern Co.	
propylene oxide	15,000
Chun Long Modern Co.	
isopropylene alcohol	21,000
China Synthetic Chemical Co.	
phenol/acetone	20,000/12,000
Tong Mei Industrial Co.	
methyl methacrylate	30,000
Lien Bon Co.	
methyl methacrylate	20,000
Taiwan Synthetic Rubber Co.	
styrene butadiene rubber	81,000
Poly Chemical Co.	
acrylonitrile-butadiene-styrene resin	10,000
Nan Ya Plastics Corp.	
acrylonitrile-butadiene-styrene resin	10,000
Shin Fong Resin Co.	
acrylonitrile-butadiene-styrene resin	6,000
Chung Tai Co.	
caprolactam	100,000
Taiwan Caprolactam Corp.	
caprolactam	100,000
Chinese Petrochemical Development Corp.	
dimethyl terephtalate	53,000
Hercules Incorporation	
dimethyl terephatalate	100,000
Harry Gilmore Amoco Chemicals, Inc.	
pure terephthalic acid	100,000
Taiwan Plasticizer Corp.	
phthalic anhydride	80,000
Lien Chen Co.	
phthalic anhydride	33,000

Control-room facilities found in power plants in Taiwan are modern, having remote control switches and automatic devices. Indicators are normally of the analog type. It is estimated that in each of the nuclear plants there will be 80 to 100 closed loops.

Process control instruments expected to be in demand in this sector include the following:

- Resistance and bimetallic temperature sensors
- Radiation pyrometers
- Pressure/vacuum sensors
- Flow sensors
- Liquid level sensors
- pH and oxidation-reduction potential sensors
- Conductivity sensors
- Conductivity reference cells
- Oxygen analyzers
- Pneumatic positioning nonbalance transmitters
- Electronic transmitters (induction, force-balance, potentiometric)
- Data loggers
- Annunciators
- Pneumatic and electric proportional and proportional plus reset analog controllers for temperature, pressure, flow, and level

Duties and Trade Regulation

Applicable customs duties on importation of process control instruments are generally 20%. However, duties on some of this equipment are as high as 46%.

Information on specific duty rates may be obtained from the Domestic and International Business Administration, U.S. Department of Commerce, Room 4016, Main Commerce Building, Washington, D.C. 20230.

Information on Taiwan's standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Table 5.—Taiwan: Number of establishments by industry and employment size

Industry	Large (over 500 workers)	Medium (100 to 500 workers)	Small (fewer than 100 workers)
Natural gas liquids	1	—	—
Food processing	50	430	31,000
Paper and paper products	6	50	453
Chemical processing	45	300	3,351
Petroleum	4	20	128
Stone, clay, and glass	12	150	2,272
Primary metals	6	78	226
Utility services	2	—	—

Source: Bureau of International Commerce market research study.

The following market research survey is available on loan from the U.S. Department of Commerce, Domestic and International Business Administration, Room 1063, Main Commerce Building, Washington, D.C. 20230: "The Market for Process Control Instrumentation," DIB 74-09-509, March 1974.

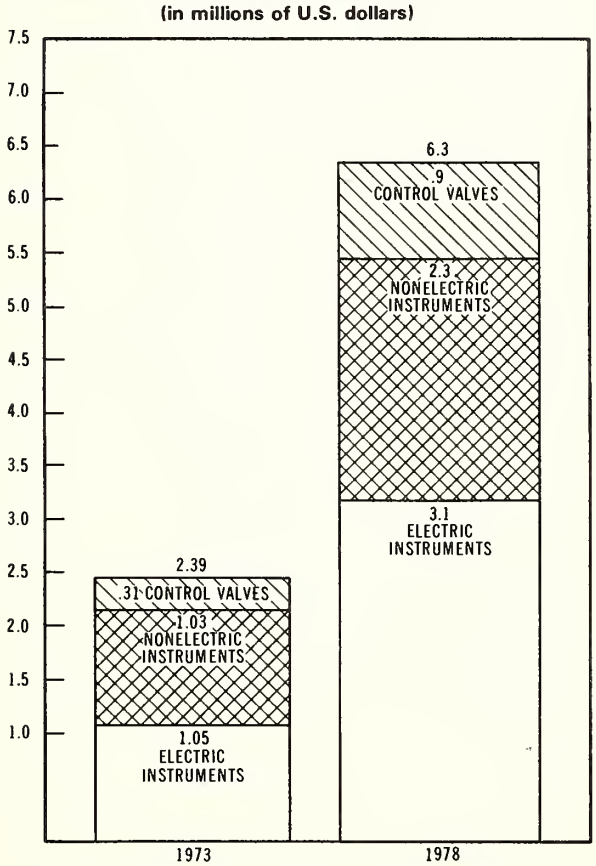
The Philippines

The Philippine market for process control instruments, estimated at $2.8 million in 1974, is projected to reach $6.3 million in 1978, representing a vigorous average annual growth of more than 22% over the 4-year period.

Governmental support for expansion and modernization of the industrial base is a major factor contributing to the rising demand for these instruments in the Philippines.

Expansion within the top three end-user industries—petroleum, utility services and chemical processing—contributed to the 13% average annual growth of the process control instrumentation market between 1970 and 1973. During that period, sales grew from over $1.7 million to almost $2.4 million (see table 1).

Philippines: Size of market for process control instrumentation, 1973 and projected 1978



Source: U.S. Department of Commerce, Bureau of International Commerce market research study. Values based on Philippine trade source estimates.

Major additions to the country's electricity generating capacity will offer good sales opportunities for process instrument manufacturers during the 1974-78 period. In addition, the Manila Sewerage Systems, the largest system in the industry's water supply sector, must expand in order to service the increasingly populous Greater Manila area. Major developments in the primary metals industry include new investments now underway in the nascent nonferrous metals mills sector.

The greatest market growth is anticipated for *electric/electronic instrumentation.* Sales of these instruments are expected to increase an average of 25% a year from the 1974 level of $1.2 million to $3.1 million in 1978. The market for *nonelectric/nonelectronic instruments* also is expected to grow at a substantial rate of 18% a year during the same period. The 1978 market is forecast to reach $2.3 million, up from $1.2 million in 1974.

Between 1970 and 1973 the market for electronic instruments rose from $520,000 to $1 million, representing an average annual growth rate of 26%. During the same period, sales of nonelectronic instruments increased from $919,000 to $1 million.

Market projections for *automatic control valves* reveal an average annual growth rate of about 22%, with sales climbing from $395,000 in 1974 to almost $900,000 in 1978. Sales totaled $295,000 in 1970 and $311,000 in 1973.

U.S. sales expected to double.—American manufacturers were the leading suppliers of process con-

Philippines—Selected Indicators
(1973)

Gross national product:	**$10.7 billion**
Population:	**40.2 million**
Total country imports:	**$1.6 billion**
Total country exports:	**$1.8 billion**
Exchange rate (November 1974):	**6.72 pesos= U S $1**

trol instrumentation to the Philippine market in 1973, when imports from the United States accounted for 61% of the market. Sales of U.S.-made process instruments are expected to rise from almost $1.5 million in 1973 to over $3.1 million in 1978.

Electronic instruments offer U.S. manufacturers the best sales opportunities. American suppliers held 75% of the market in 1973, and the United States is expected to remain the leading supplier in 1978. Sales of American-made electronic instruments are expected to grow from almost $790,000 in 1973 to over $1.8 million in 1978, representing an average annual growth rate of almost 18%.

Imports of nonelectronic instruments from the United States are forecast to exceed $880,000 by 1978, rising from a level of almost $520,000 in 1973. Sales of U.S.-made automatic control valves are predicted to grow at an average rate of 17.7% a year, expanding from $156,000 in 1973 to $400,000 in 1978.

Brisk competition in import-dominated market.—Germany and Japan are the chief competitors of the United States in the Philippine process control instrumentation market (see table 2). Major foreign suppliers of process control instruments include Sakura Electric Co. and Yokogawa Electric Works of Japan; Hartman & Braun and P. Gossen & Co. GmbH. of Germany; R.G.S. Electro-Pneumatics Ltd. of England; and Brown, Boveri & Co. Ltd. of Switzerland.

Japanese suppliers benefit by their proximity to the Philippine market. Japanese manufacturers can offer faster delivery time, lower shipping charges, and better after-sales service than most European manufacturers. In addition, government-supported low interest loans are available for Japanese exports.

Japanese instruments, particularly temperature controllers, have established a good reputation in the petrochemical and sugar processing sectors. However, the recent dollar devaluations have aided U.S. suppliers in sales to these sectors.

German equipment is well known in the Philippines for its reliability, particularly in the power generation sector. The Manila Electric Power Company has installed Siemens instruments in a new thermal power plant.

There is no local manufacture of process control instrumentation and none is expected until 1978, when some production of components or accessories is expected to begin. The Philippines will have difficulty establishing domestic manufacture because the local market is too small, and the infrastructure is inadequate.

Major Industrial Users

Research conducted in the Philippines for the U.S. Department of Commerce, Office of International Marketing, surveyed seven industries and identified the sectors with the best markets for process control instrumentation. Total 1972 sales by the six major industries amounted to nearly $1.5 billion, and their purchases of control instruments are expected to grow from $1.7 million in 1972 to $4.6 million in 1978 (see table 3).

Electricity generation and distribution sector.—Electricity generation is the largest sector in the utility services industry. The industry bought process control instrumentation valued at $350,000 in 1972 and is expected to increase annual purchases to a level of $1.3 million by 1978. The industry had an estimated total of 722 establishments in 1973 (see table 4).

The electricity generation and distribution sector includes approximately 335 private electric utility companies, as well as the government-owned National Power Corporation. Privately and publicly owned plants had a combined power-generating capacity of 2,360 megawatts (MW) in 1972.

The government recently took control of the Manila Electric Company (MERALCO), the largest private company in the sector. Its six plants (five thermal and one hydroelectric) account for 64% of the country's electrical power and have a capacity of 1,514 MW. The National Power Corporation runs six large and eight small hydroelectric plants, and one thermal and six diesel plants. Based largely in Luzon and Mindanao, with small stations in Visayas, these National Power Corporation plants can produce 660 gross MW, or 28% of capacity.

The remaining 8% of installed capacity comes from the 335 privately owned electricity companies. Many of these organizations depend wholly or partly

Table 1.—Philippines: Imports of process control instrumentation, 1970, 1972-73
(in thousands of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments	520	686	1,052
Nonelectric/nonelectronic	919	1,082	1,029
Automatic control valves	295	312	311
Total process control instrumentation	1,734	2,080	2,392

Source: Bureau of International Commerce market research study.

on the two large firms for their power supply. Total sales of the privately owned companies totaled $95 million in 1972. In addition, about 130 power companies are municipally owned, with an average capacity of 25 kilowatts (KW).

The Philippine Government has embarked on an ambitious new program to provide electric power throughout the country. A $258-million capital expansion program scheduled over the 4-year period from 1974 to 1978 should increase the country's gross aggregate capacity by 460 MW by the end of 1977. This investment includes the construction of 1,324 kilometers (km) of transmission lines in Luzon and 1,150 km in Mindanao.

The rural electrification program plans to establish electric cooperatives throughout the country, with 4-year expenditures expected to total $71.7 million. By 1977-78, 36 cooperatives, each to serve 5 to 10 municipalities, or 100,000 to 200,000 people per system, are scheduled to service four million people.

A number of specific projects are planned. Two geothermal units will soon be under construction in Tiwi, where Philippine Geothermal Incorporated, a subsidiary of Union Oil Company of California, expects to have two 10-MW plants operational by 1975. The purpose of the project is to harness geothermal activity for electric power. If results are favorable, two additional 25-MW units will be erected by 1978.

A thermal unit in Bataan, targeted for completion in 1976, will burn high-viscosity oil to generate 150 MW; the project will cost in excess of $24 million. Other plans include the Upper Pampanga River Project Power Phase, with power-generating facilities for 100 MW, due to be completed in 1977, and the fifth Maria Cristina Hydroelectric plant, due for completion in 1975. Other hydroelectric projects include the Agus plants, whose total costs when completed in 1980 will be $81 million.

Finally, work is slated to begin in 1976 on a 600-MW nuclear power plant at an approximate cost of $149 million. This nuclear project is expected to require about 100 closed process control loops when completed in 1980.

The following types of process control instruments will be particularly sought after in the expanding electricity generation and distribution sector:

- Data loggers
- Annunciators
- Analog and digital panel meters
- Oxygen analyzers
- Manometers and barometers
- Sensors
- Transmitters
- Controllers

Table 2.—Philippines: Imports of selected process control instrumentation[1] by country of origin, 1970, 1971, and 1972

(in thousands of U.S. dollars)

	1970	1971	1972
Taps, cocks, valves, and apparatus of base metals regulating the flow of fluids			
United States	824	673	1,242
Japan	629	790	520
Denmark	310	457	462
United Kingdom	830	571	345
Others	465	429	377
Total	3,058	2,920	2,946
Electric instruments for measuring checking, calibrating, or controlling and analyzing, except current controls			
United States	156	264	124
Japan	93	132	72
Hong Kong	1	1	27
United Kingdom	11	15	20
Others	79	109	77
Total	340	521	320
Measuring, controlling, and scientific instruments n.e.s.			
United States	302	572	540
Japan	181	232	249
Germany	33	161	68
Taiwan	8	7	54
Others	297	366	199
Total	821	1,338	1,110

[1] Includes some scientific and analytical instruments.

Source: Based on data provided by the Central Bank of the Philippines.

- Computer system for logging, scanning, and alarming
- Supervisory control systems

Process control systems used in the Philippines generally reflect a growing sophistication. Control rooms in power plants have both centralized and local control points, with an emphasis on pneumatic controls and analog readouts.

The new nuclear plants will feature fully automated control systems capable of conversion to manual control from the control board. These plants will be designed with both pneumatic and electric instrumentation and will monitor plant output, feedwater flow, combustion, main and reheat steam temperature, and air heater cold-end temperature.

Primary nonferrous metal mills sector.—The primary metal industry is the fastest growing end-user of process control instrumentation in the Philippines. Although this sector purchased only 14% of the total process instruments sold in 1972, the industry is expected to account for 20% of the total market by 1978, making it the second largest user industry.

Table 3.—Philippines: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Total Sales 1973	Process Control Instrumentation Consumption 1972	1978
Food processing	570	.23	.57
Chemical processing	370	.33	.95
Petroleum	200	.37	1.20
Primary metals	152	.29	1.27
Utility services	n.a.	.35	1.33
Paper and paper products	85	.29	.57
Stone, clay, and glass	80	.19	.38

n.a.—not available.
Source: Bureau of International Commerce market research study.

The steel mill sector is the largest in the industry, comprising some 26 firms with aggregate annual sales of $100 million or 66% of total industry sales. By comparison, the primary nonferrous metals mills sector is small, with only four firms (dealing with aluminum and copper raw materials) in operation, and a total employment of about 1,000 workers. Total annual sales amounted to $4 million in 1973, in addition to $2 million in annual sales from the nonferrous foundry field. In spite of the relatively modest scale of this sector, its rapidly accelerating growth will make it a major new market for process control instruments.

Recent government efforts to promote exports of processed rather than raw materials should create an environment for rapid expansion in the sector over the coming years. The government is encouraging foreign investment, and the major mining firms are expected to initiate smelter operations during the 1974-78 period. The mining companies are major enterprises, the 14 largest having produced minerals valued at over $280 million in 1973. Capital expenditures are expected to reach $40 million in 1974. Although the government is not investing directly in the sector, it supports the mining companies by providing geological surveys, mine services, and metallurgical and laboratory services.

Reynolds Aluminum is scheduled to construct an aluminum smelter by 1975. Its capacity is to be 30,000 metric tons (MT) of metal per year, and it will cost about $88 to $100 million. A copper smelter with an annual capacity of 80,000 MT of metal is now under construction by Lepanto Consolidated Mining at a cost of between $70 and $100 million; completion date is set for 1975 or 1976. Also, projects for copper concentrate production facilities and nickel smelting plants by a number of interested mining firms are in the planning stages.

Those process control instruments expected to be most in demand in the rapidly expanding nonferrous metal mills sector include the following:

- Spectrophotometers
- Turbidimeters
- pH and oxidation-reduction potential electrodes
- Scan monitors
- Annunciators
- Resistance and bimetal temperature sensors

Process control systems presently in this sector depend largely on localized instrument usage. Operators normally manipulate the instrument directly, since most are installed on or near the machines and processes. The new large smelter projects, however, will make use of centralized as well as local control systems.

Duties and Trade Regulations

Customs duties for process control instrumentation in the Philippines range from 10 to 20% and, consequently, are not a significant impediment for access to the Philippine market.

Information on specific duty rates may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 4012 Main Commerce, Washington, D.C. 20230.

Published national standards for process control instrumentation in the Philipines may be obtained through the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

Table 4.—Philippines: Number of establishments using process control instrumentation, by industry and employment size, 1973

Industry	No. of establishments Large (over 500 employees)	Medium (100 to 500 employees)	Small
Food processing	40	98	1,024
Chemical processing	9	52	131
Paper and paper products	5	7	6
Utility services	3	20	699
Petroleum	3	3	6
Primary metals	2	15	50
Stone, clay, and glass	1	28	145

Source: Economic Census of the Philippines, 1967 and trade source estimates.

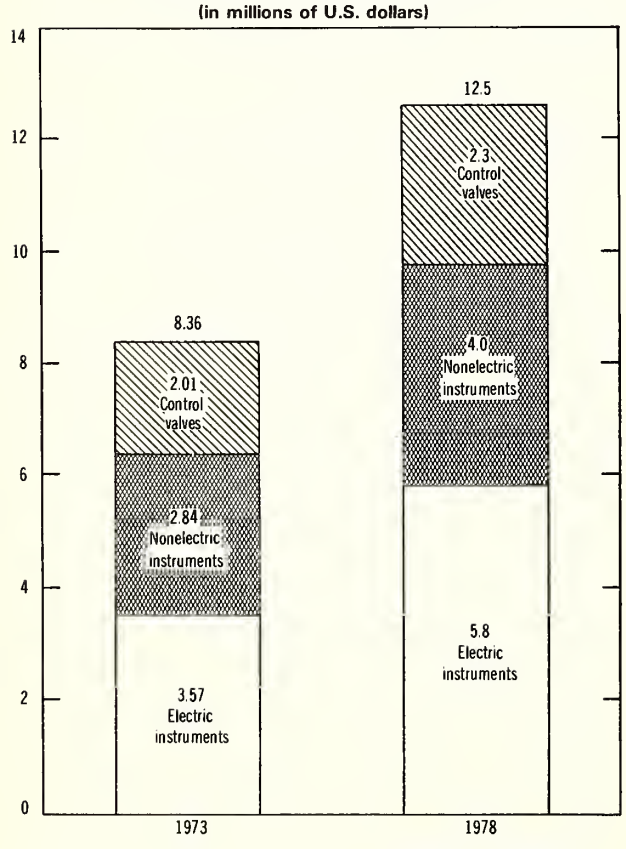
The following market research survey is available on loan from the U.S. Department of Commerce, Domestic and International Business Administration, Room 1063 Main Commerce Building, Washington, D.C. 20230: "The Philippines Market for Process Control Instrumentation," DIB 74-12-544, March 1974.

Singapore

The Singapore Government's plans for a major petrochemical complex and new construction in the electrical energy sector are expected to help push sales of process control instrumentation to $12.5 million in 1978.

The market grew from an estimated $4.3 million in 1970 to $8.3 million in 1973, representing a brisk 25% average annual growth rate (see table 1). Expansion of the petroleum, chemical, and utilities industries, which together accounted for 91% of purchases of control instrumentation in 1972, has been the major factor underlying the rapid growth of the market.

Singapore: Size of market for process control instruments, 1973 and projected 1978



Source: Bureau of International Commerce, Office of International Marketing research study.

Electric/electronic instrument sales are growing at a faster pace than *nonelectric/nonelectronic instruments.* Between 1970 and 1973, electric instrument sales increased by an average of 37% annually, while the market for nonelectric instruments grew by only 13% per year. This trend is expected to continue, with sales of electric instruments totaling $5.8 million in 1978, while the market for nonelectric instruments will reach $2.8 million.

Trade sources in Singapore explain that the newer electronic devices are well accepted in the market because of faster reaction times, greater ease of repair, and even lower costs in some instances than pneumatic or hydraulic devices. Furthermore, electric systems could not heretofore be used in certain chemical processes for fear of explosions, but the new electronic systems have been designed to be intrinsically safe. Also, the trend toward computerization may necessitate replacement of nonelectric instruments with electronic systems that will be compatible with a computer. Even though the electric/electronic category enjoys a favored position, other factors, such as the cost differential, advantage of pneumatic instruments for short distances, susceptibility of electronic instruments to signal pickup, and need for special training in their use, all point to a continuing demand for pneumatic and hydraulic systems in the Singapore market.

Sales of *automatic control valves* are expected to exceed $2.7 million in 1978, representing a 35% increase over the 1973 level of $2 million.

U.S. firms supply one-fourth of market.—Singapore's requirements for process control instruments

Singapore—Selected Indicators (1973)

Gross domestic product:	**$3.66 billion**
Population:	**2.2 million**
Total country imports:	**$5.03 billion**
Total country exports:	**$3.58 billion**
Exchange rate (Dec. 1974):	**Fluctuating at about S$2.38 =US$1**

are met by imports, since there is no domestic production. Approximately 12.5% of imports were reexported in 1973. Imports, valued at $4.9 million in 1970, climbed at a substantial rate of 25% annually to reach $9.6 million in 1973. Expansion is expected to continue at the slower rate of 7.8% per annum, reaching an estimated level of $14 million in 1978.

Control instrument imports from the United States, estimated at $1.3 million in 1970, rose to $2.3 million in 1973 and are expected to total $3.3 million in 1978, representing 25% of foreign sales in that year. American firms sold $1.2 million worth of electric/electronic instruments in 1973 and should supply $1.8 million worth to Singapore in 1978. Sales of U.S. control instruments of other types are also expected to increase gradually between 1974 and 1978. Imports of nonelectronic instruments from the United States are expected to reach $1.2 million in 1978, while U.S. sales of automatic control valves should total $370,000.

In the largest end-user sectors, such as petrochemicals, oil refineries, and electric utilities, U.S. process control equipment holds a very favorable position. Sales opportunities are especially good for the following instruments: flowmeters (turbine, mass, and positive displacement types), tachometers, stroboscopes, hygrometers, hygroscopic analyzers, all types of sensors to measure the moisture content of solids, spectrometers, power converters, signal converters, all types of transmitters, controllers, monitors, data loggers and indicators, control valves, and measuring and control systems (including computer systems).

In addition to sales of American-made control instruments, imports from third countries are thought to include a significant share from U.S. subsidiaries or licensees abroad. For example, Foxboro, Honeywell, and Taylor products may be supplied from their subsidiaries and manufacturing joint ventures in Japan, Australia, or Europe.

U.S. firms can improve their position in this highly competitive market by providing better local technical service facilities, increasing and improving local representation, speeding up deliveries, and advertising new technological developments. American consulting engineers and contractors operating in Singapore should be made aware of new developments in the industry, because they normally prefer U.S. instrumentation.

Japan leader among U.S. competitors.—Major competition for U.S. control instruments comes from Japan, Germany, and the United Kingdom (see table 2). Each of these nations possesses certain unique advantages which help them secure sizable shares of the Singapore market.

The Japanese derive advantages from their ability to make prompt deliveries and from their financing arrangements. Japanese construction and consulting firms in oil refinery and chemical plant developments in Singapore recommend their own suppliers and control instruments. For example, the Sumitomo Chemical Company has reached a basic agreement with the Singapore Government to establish a naphtha-processing facility that would include a steam cracker with an annual capacity of 300,000 tons of ethylene, as well as integrated later-stage production of polypropylene, polyethylene, polyvinyl choride, polystyrene, and textile intermediates. Such a project, costing more than $300 million, is significant because process control instrumentation for an estimated 1,000 closed loops will be required.

Japanese suppliers of control instruments to the Singapore market include Fuji Koki Manufacturing Co., Hitachi Ltd., Nagano Keiki Seisakusho Ltd., Sakura Electric Co., Tokico Ltd., Yamatake-Honey-

Table 1.—Singapore: Size of market for process control instrumentation, 1970, 1972, and 1973
(in thousands of U.S. dollars)

	1970	1972	1973
Electric/Electronic instruments			
Imports	1,559	2,403	4,032
Exports	188	353	520
Market size [1]	1,371	2,050	3,512
Nonelectric/nonelectronic instruments			
Imports	2,240	2,403	3,264
Exports	270	353	420
Market size	1,970	2,050	2,844
Automatic control valves			
Imports	1,071	1,201	2,304
Exports	130	177	300
Market size	941	1,024	2,004
Total process control instrumentation			
Imports	4,870	6,007	9,600
Exports	588	883	1,240
Market size	4,282	5,124	8,360

[1] Market size equals imports minus exports, since there is no domestic production.

Source: Bureau of International Commerce, Office of International Marketing research study.

well Co. Ltd., and the Yokogawa Electric Works. One or more of these firms in all likelihood will be specified to supply the important Sumitomo project. Japanese suppiers are particularly strong in supplying flow orifices, ultrasonic resonance gages, and electronic instruments.

United Kingdom suppliers of process control instrumentation hold a favored position in the market due to former colonial ties with Singapore. The Singapore Government's equipment specifications are based on British standards, giving U.K. suppliers a distinct advantage. The leading supplier, Kent Instruments, and other British firms have a good reputation in the fields of bellows and diaphragm pressure/vacuum sensors, venturi and pitot flowtubes, density sensors, and automatic control valves.

Many leading German suppliers, such as Eckart-Werke and Siemens AG, rely on strong local representation to promote their products. German-made temperature sensors, magnetic flowmeters, analog controllers, and electrical panel meters are highly regarded in the Singapore market. Another advantage is the high level of technical competence of their service personnel.

Singapore has no local production of process control instruments except for a small amount of custom fabrication of panel boards. With a full range of equipment quickly available duty-free from Australia or Japan, there is little likelihood of domestic production developing under present conditions.

Major Industrial Users

Research recently conducted in Singapore for the U.S. Department of Commerce, Office of International Marketing surveyed seven industries which accounted for almost all of the process control instrumentation purchases in 1972 (see table 3). The three largest purchases are the petroleum, utility services and chemical processing industries.

Petroleum refineries sector.—Output in the petroleum industry totaled $587 million in 1972. Products of the petroleum refineries sector include aviation fuel, brake fluids, diesel fuels, fuel oils, gas lighter fluids, lubricating grease, kerosene, gasoline, and liquid petroleum gas. The miscellaneous petroleum products manufacturing sector produces a variety of asphalt and bitumen materials. The petroleum industry will probably purchase process control instruments valued at over $6 million in 1978.

Singapore is one of the largest concentrated refining centers in the world, with five major refineries and a total capacity of almost 1 million barrels per day (bbl/d). Estimates of fixed capital assets of the refining sector alone run as high as $600 billion. Output in 1972 was estimated at $665 million, representing over 30% of total manufacturing in Singapore. Only about 9% of refinery output in 1972 was sold in Singapore, the remainder being exported mainly to Japan, South Vietnam, Hong Kong, Australia, and Thailand.

Table 2.—Singapore: Imports of selected process control instruments by country of origin, 1970-72
(in thousands of U.S. dollars)

	1970	1971	1972
Electrical instruments for measuring nonelectric quantities			
United States	1,955	2,495	3,870
Japan	1,513	815	1,906
Hong Kong	18	9	966
France and Monaco	155	121	480
Others	1,244	1,392	2,345
Total	4,885	4,832	9,567
Instruments for measuring or controlling liquids or gases			
United States	436	474	752
Japan	272	344	498
United Kingdom	210	263	428
West Germany	82	76	113
Others	293	440	457
Total	1,293	1,597	2,248
Taps, cocks, valves, and similar appliances			
United States	786	1,748	3,639
Japan	1,354	1,479	4,114
United Kingdom	1,968	2,642	3,603
The Netherlands	259	318	553
Others	1,705	2,027	2,552
Total	6,072	8,214	14,461

Source: Values based on data from the Singapore Government, Department of Statistics.

The large refineries—Esso, Shell, Mobil, British Petroleum and Singapore Petroleum, the last-named partially owned by the Government in cooperation with American firms—account for all production in the sector.

All refineries are almost continually making additions and improvements to their facilities. In 1973, Esso embarked on a program, scheduled for completion in 1975, which involves a 100-150% increase in capacity. Mobil recently completed a program that increased its capacity six times to 150,000 bbl/d at a cost of $50 million. Although neither Esso nor Mobil has any specific new plans for major expansion, each firm anticipates that further capacity additions will be necessary in about 1978.

Shell's Singapore facility is the largest refinery complex in Asia, with production capacity of 400,000 bbl/d. British Petroleum has a capacity of

Table 3.—Singapore: Consumption of process control instrumentation by major industries
(in thousands of U.S. dollars)

Industry	1972	1978
Food processing	256	504
Paper and paper products	51	126
Chemical processing	410	3,654
Petroleum	3,484	6,300
Stone, clay and glass	51	126
Primary metals	102	378
Utility services	769	1,512

Source: Bureau of International Commerce, Office of International Marketing research study.

about 50,000 bbl/d and Singapore Petroleum a capacity of 75,000 bbl/d. When the Sumitomo petrochemical project comes on stream, Singapore Petroleum may try to expand its facilities to meet the naphtha demands of that complex.

The following process control instruments are expected to be in demand for this sector:

- Resistance, bimatellic, and thermocouple temperature sensors
- Potentiometric and thermoelectric pyrometers
- Bourdon tube, bellows, and diaphragm pressure/vacuum sensors
- Orifice flow sensors
- Turbine and positive displacement flowmeters, rotameters, anemometers
- Diaphragm, float, and pressure gage liquid level sensors
- pH sensors
- Oxygen analyzers
- Electric to pneumatic/pneumatic to electric converters
- Temperature, pressure, flow, and level transmitters
- Positioning nonbalance and force-balance pneumatic transmitters
- Telemetric frequency and pulse transmitters
- Analog controllers and continuous monitors
- Annunciators
- Automated control valves with pneumatic and electric actuators
- Pneumatic and electropneumatic valve positioners
- Single-variable, multiple-variable, cascade pneumatic and electropneumatic measuring control systems

In general, the refineries have not yet reached the stage of advanced automation. Only Esso has a computer installation. At Shell there is no centralized control system, but rather three control rooms to operate different parts of the refinery complex. Also at Shell, there is a mixture of pneumatic and electric instrumentation, with emphasis on the former for reasons of price. Electronic instruments will be used when transmission over long distances is necessary.

Electric generation and distribution sector.—The Government-owned utility services industry was the second-largest purchaser of process control instrumentation in 1972, with consumption totaling $768,000. Trade sources predict that 1978 expenditures on these instruments will exceed $1.5 million.

The electricity generation and distribution sector is one of the largest segments of the utility industry. Production of electricity in recent years has grown rapidly and now exceeds 3 billion kilowatthours per year. The Public Utilities Board operates five electric power stations, including the St. James Power Station (49 megawatts (MW)), Pasir Panjang "A" Power Station (175 MW), Pasir Panjang "B" Power Station (240 MW), Jurong Stage I Power Station (240 MW), Jurong Stage II Power Station (360 MW), and the Senoko Gas Turbine Generating Station (45 MW).

The first stage of the Senoko Power Station, now under construction, will comprise three units of 120 MW each and is scheduled to go into operation by 1976. This stage will require an estimated $3.2 million in process control instruments. Construction of Stage II is to begin in 1975 and is slated for completion in 1978. This second stage will have three 250-MW units with a computerized control system valued at approximately $8 million. An estimated total of 120 closed loops will be required for these two projects.

The older power generation plants in Singapore rely on pneumatic control systems with analog readout panels in their control rooms, but the new Senoko station will place greater emphasis on electronic instrumentation. An exception would be instances involving distances from the sensor point and the control room of less than 300 feet, in which cases pneumatic systems will be used.

Table 4.—Singapore: Number of establishments by industry and employment size

	Number of establishments		
	Large: over 100	medium: 50-99	Small: 10-49
Industry	workers	workers	workers
Food processing	31	29	189
Paper and paper products	6	19	42
Chemical processing	8	16	71
Petroleum	6	—	3
Stone, clay, and glass	5	16	122
Primary metals	4	2	11

[1] Establishments with fewer than 10 employees were not covered in the Census.

Source: Based on the 1972 Singapore Census of Industrial Production.

Process control instruments expected to be in demand in this sector include the following:

- Conductivity reference cells
- pH meters
- Pressure gages
- Float, diaphragm, and bellows liquid level sensors
- Positive displacement meters
- Mass flowmeters
- Bourdon tube, bellows, and diaphragm pressure/vacuum sensors
- Resistance, bimetallic, and thermocouple temperature sensors
- Data loggers
- Annunciators
- Electronic analog temperature, pressure, flow, and level indicators and recorders; analog panel meters
- Globe, angle, three-way, butterfly, and butterfly-lined valves
- Pneumatic actuators and positioners
- Self-contained direct actuated pressure regulators
- Multiple-variable electronic and pneumatic measuring and control systems
- Digital monitoring elements

Industrial chemical processing sector.—The chemical processing industry accounted for only 8% of the control instrument market in 1972, but this percentage is expected to increase to 29% by 1978, representing sales of $3.6 million in the latter year. Total sales of industrial chemicals in 1972 amounted to $23 million. Eighteen firms manufacture industrial gases; dry ice; basic industrial chemicals; pesticides, insecticides, and herbicides; and synthetic resins, plastic materials, and man-made fibers. In addition, 1972 sales of paints, varnishes, and lacquers amounted to $9.3 million; medicinal and pharmaceutical products, $4.2 million; soap and other washing and cleaning products, $6.8 million; perfumes, etc., $6.9 million; and other chemical products, $7.4 million.

The Singapore Government, in conjunction with the Sumitomo Chemical Company, plans to build a major petrochemical complex, costing over $300 million, to process naphtha. The facility is expected to have a steam cracker with an annual capacity of 300,000 tons of ethylene, together with integrated downstream processes for the production of polypropylene, polyethylene, polyvinyl chloride, polystyrene, and textile intermediates. The project should require 1,000 closed loops.

Duties and Trade Regulations

There is no duty on process control instrumentation imported into Singapore.

Information on the availability of Singapore's standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Singapore to supplement this report is available on a continuing basis from:

Country Marketing Manager—Singapore
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-3875

A loan copy of the original research is available from:

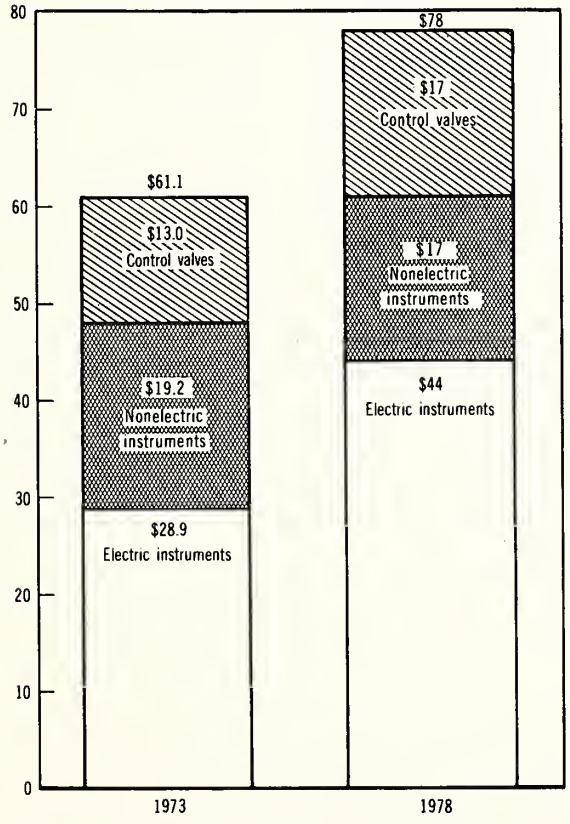
Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in Singapore," DIB 74-08-504, March 1974. The Office of Export Development also has available for $3.00 a "Target Market Trade List: "Process Control Instrumentation—Singapore," which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

Spain

Spain's Government is striving to broaden the country's industrial base and improve overall production efficiency. The Third Development Plan, covering the 1972-75 period, includes among its goals self-sufficiency in steel, a dramatic rise in electricity generation capacity, and a shift toward large-scale processing in the chemical industry. One result of these efforts is a growing market for process control instruments. Sales of this equipment rose an average 4.8% yearly, from $53.1 million in 1970 to $61.1 million in 1973, and are expected to increase more than 5% annually after 1973, passing the $78 million level by 1978 (see table 1).

Spain: Size of market for process control instruments, 1973 and projected 1978
(in millions of U. S. dollars)



Source: U. S. Department of Commerce, Bureau of International Commerce market research study. Values based on Spanish trade source estimates.

Demand is growing rapidly for *electric/electronic instruments,* which are now used in all of Spain's basic process industries. Sales of these items reached $28.9 million in 1973, a 6.5% average annual gain over 1970's market of $23.9 million. A growing sophistication in processing techniques and construction of several nuclear power stations should help raise the average annual growth rate for purchases of electronic instruments to a strong 9% between 1973 and 1978. The market is predicted to surpass $44 million in 1978.

Although sales of *nonelectric/nonelectronic instruments* grew an average of 3% annually from 1970 to 1973, consumption is expected to decline more than 2% annually through 1978. A trend toward wider application of electronic instruments, plus a relatively stable level of annual investment in the hydrocarbon-based industries that use primarily pneumatic and mechanical devices, should lower 1978 sales to slightly over $17 million.

The development of additional production capacity in the chemical processing and petroleum industries helped fuel a 3.9% average annual growth in Spain's *automatic control valve* market between 1970 and 1973. Sales rose from $11.6 million in 1970 to $13 million in 1973 and are forecast to increase by more than 5.5% annually until 1978, when the market should approach $17 million.

U.S. position strong in instrument market.— Spanish consumers depend on imports for at least 75% of their process control instruments. U.S. designs are strongly preferred, whether imported from U.S.-based companies or their European subsidiaries

Spain—Selected Indicators (1973)

Gross national product:	$62.2 billion
Population:	34.8 million
Total country imports:	$9.5 billion
Total country exports:	$5.1 billion
Exchange rate (December 1974):	Fluctuating at about 58 pesetas = U S $1

or licensees. The substantial growth in demand predicted for electronic and nucleonic instruments cannot be met by local manufacturers nor satisfied entirely from European sources. American-made products dominate this fast-growing market, and imports of these items from the United States are expected to increase during the next 5 years. The United States held the major share (26 to 29%) of the import market for electronic instruments throughout the 1970-72 period (see table 2).

Specific products that are highly regarded by Spanish end-users include transmitters built by ITT Barton, and Foxboro; on-line analyzers from Beckman, Foxboro, and Leeds and Northrup; Masoneilan's local controllers, especially the displacement level type; and Foxboro's Spec 200 electronic control system. U.S. manufacturers are considered without rival when it comes to instruments designed to withstand unusual stress, such as seismic shock or irradiation.

Half of the 10 leading producers of process control instruments in Spain are U.S. subsidiaries or licensees. The two largest, Fischer and Porter Iberica S.A. and Honeywell S.A., are both direct subsidiaries, and each has a staff of about 250 employees. They assemble some of the basic types of instruments, but primarily import the parent company's product line. Fischer and Porter Iberica also manufactures some pneumatic control valves under license from Adar S.A., of France.

Masoneilan International Inc. has a Spanish subsidiary with 80 employees manufacturing pneumatic control valves and positioners, as well as level and pressure transmitters and controllers. Complete electronic control systems are sold through Meci Hispania S.A., a subsidiary of Meci S.A. of France, which in turn is a licensee of Leeds and Northrup. Meci Hispania's plant, with about 30 employees, markets potentiometric recorders, electro-chemical analyzers, and multipoint digital temperature indicators, some of which are assembled in Spain.

Products of American design are also sold through a subsidiary of Auxitrol of France which holds licenses from several U.S. firms, including Mercoid, Asco, Conax, Edison, Farmer Electric, Peeco, Vulcan, and Conoflow VAF. Auxitrol Iberico S.A., with a staff of 50 employees, manufactures or markets items such as temperature, pressure, and level indicators; switches; alarm systems; annunciators; manometers; counters; integrators; solenoid valves; and positive displacement flowmeters.

Limited market penetration by European manufacturers.—Despite strongly entrenched American presence, some European suppliers have established themselves in certain sectors for sale of specific products. The United Kingdom's George Kent Group supplies valves and electronic instruments, and Kent-Tieghi (a British and Italian joint venture) markets their pneumatic instruments in Spain. Several German suppliers have also entered the process control instrumentation market in Spain. Hartmann & Braun is active in the iron and steel sector; Siemens has installed control equipment in several coal-fired power stations; and Gulde is an important supplier of control valves. The Italian firm Nuovo Pignone also sells control valves. Some Swiss and Danish instruments have been imported by the food and beverage industries to meet special requirements, particularly in milk processing and brewing.

Four subsidiaries of European firms are among the top 10 domestic producers of process control instruments in Spain. The four companies have from 30 to 100 employees each. Bourdon Espanola S.A., a subsidiary of Ets. Bourdon of France, produces pressure gages and temperature indicators. Control panels and alarm systems are built by a subsidiary of Comsip Automacion of France. Kent Iberica S.A., part of the George Kent Group, supplies all of the parent company's products and assembles low-cost temperature and level measurement instruments and some panels and systems. Italy's Spriano S.A. has a subsidiary in Spain which produces pressure gages and temperature and level indicators. Spriano Espanol also imports instruments such as transmitters, recorders, and local pneumatic controllers from the parent firm.

Altogether, some 25 companies make process control instruments in Spain. Only one domestically owned company, Transmetal S.A., is among the 10 leading manufacturers. This firm, ranking fifth in the

Table 1.—Spain: Size of market for process control instrumentation, 1970, 1972, and 1973

(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments	23.9	28.7	28.9
Nonelectric/nonelectronic instruments	17.6	18.6	19.2
Automatic control valves	11.6	12.8	13.0
Total process control instrumentation	53.1	60.1	61.1

Source: Bureau of International Commerce market research study.

industry, has 50 employees and annual sales of approximately $600,000. The company produces radiation pyrometers; thermocouples; resistance thermometers; level regulators; recorders; motorized and solenoid valves; and temperature indicators, regulators, and controllers.

Seven other Spanish-owned firms, all located in the Barcelona area, manufacture indicators, recorders, pressure gages, and some simple controllers. The total business volume of these smaller Spanish producers amounted to approximately $700,000 in 1973. These firms, mainly family companies, are not significant in any of the major market sectors. The highly fragmented food and beverage industry buys most of their products.

Major Industrial Users

Seven basic industries that account for approximately 85% of Spain's process control instrument market were surveyed for the U.S. Department of Commerce, Office of International Marketing. Combined sales of $16.8 billion and capital investments of $1.5 billion were recorded for the seven industries in 1972 (see table 3). Investment in process control instrumentation is expected to rise over the next 5 years for five of the surveyed industries. Instrument purchases by the utility services, chemical processing, primary metals, paper and board, and the food processing industries are expected to increase from $46.5 million in 1972 to $64 million in 1978. While overall spending by the petroleum industry is expected to decline, the Spanish Government definitely plans to expand petroleum refineries, and this sector offers an excellent potential market for American producers of process control devices. The expected slowdown in control instrument purchases in the natural gas industry is related to a temporary suspension of new construction until the Mediterranean pipeline is completed. This direct supply of natural gas will feed into Spain's national pipeline network, scheduled for construction in the 1980's.

Three industries; namely, utility services, chemical processing and primary metals, were found to consume 70% of all process control equipment purchased in Spain in 1972. They employed a total of 472,000 persons in 8,161 establishments in the same year (see table 4). Their combined 1972 sales exceeded $9 billion, and more than $1 billion was allocated for capital investments. The three fastest growing sectors within these industries have been selected for more detailed review.

Electricity generation and distribution sector.— The utilities services industry is by far the largest user of process control instruments in Spain and is expected to account for nearly 35% of the market in 1978. Out of a total capital investment of $651 million, nearly $17 million was spent for process instrumentation in 1972. These purchases are forecast to advance more than 8% annually, reaching $27 million a year by 1978.

Table 2.—Spain: Imports of selected process control instruments [1] by country of origin, 1970, 1971, and 1972

(in millions of U.S. dollars)

	1970	1971	1972
Taps and valves of all types, including pressure-reducing and thermostatically controlled valves BTN 84.61.00			
United States	5.5	5.6	6.5
Germany	6.9	5.6	7.8
Italy	2.7	3.4	4.4
France	3.9	3.6	4.3
Other	4.9	6.5	8.6
Total	23.9	24.7	31.6
Process control instruments, except thermostats, for measurement or control of flow, level, pressure, or temperature BTN 90.24.09			
United States	1.8	2.1	1.8
United Kingdom	1.2	1.0	1.6
Germany	1.8	1.3	1.3
France	1.0	1.0	0.9
Other	1.7	2.2	2.6
Total	7.5	7.6	8.2
Process control type electric and electronic instruments and apparatus [2] BTN 90.28.99			
United States	6.2	6.0	9.5
Germany	5.7	6.2	8.5
United Kingdom	2.1	2.5	3.9
France	2.4	2.1	2.5
Other	4.7	5.6	11.7
Total	21.1	22.4	36.1

[1] Includes some items other than process control instruments.
[2] Excludes on-line analytic instruments, electroscopes, electrometers, dosimeters, and other instruments for measurement of electronic magnitudes.
Source: Values based on official Spanish trade statistics.

Spain's rapidly developing electricity generation and distribution sector, employing approximately 50,000 people, is regulated by the Ministerio de la Industria and Unidad Electrica S.A. (UNESA), a public corporation. Except for Union Electrica S.A., all major companies are privately owned, although the State has invested in some of the smaller generating facilities. Electricite de France, the only appreciable foreign presence in the sector, has a 25% interest in one nuclear power plant.

Eight electricity generating firms employed more than 2,000 people each in 1972 and accounted for 78% of the sector's $1.2 billion sales total. The combined sales of the three largest firms, Hidroelectrica Espanola S.A., Iberduero S.A., and Fuerzas

Table 3.—Spain: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Sales 1972	Capital Investment 1972	Process Control Instrumentation Consumption 1972	1978
Utility services	1,373	651	16.72	27.0
Chemical processing	4,752	239	11.85	16.4
Primary metals	3,124	333	13.30	15.6
Food processing [1]	5,378	122	3.43	3.5
Petroleum	1,000	116	5.11	2.0
Paper and board	887	49	1.20	1.8
Natural gas liquids	349	n.a.	0.36	0.2

[1] Does not include beverage sector.
Source: Bureau of International Commerce market resarch study.

Electricas de Cataluna S.A., amounted to $505 million. Spain's 1972 electricity output, excluding user-generated power, came to almost 77 billion kilowatts (kW).

The Spanish Government is already expanding the country's electricity generation and distribution capacity as rapidly as possible, as part of its plan to provide the infrastructure for further industrialization. Expenditures for fixed generation plant and equipment reached approximately $450 million in 1972, and output capacity was enlarged by 6% in 1973 to over 23,000 megawatts (MW). The Plan Electrico Nacional (PEN) calls for more than doubling generating capacity by 1983 (see table 5).

Empresa Nacional de Electricidad S.A. intends to build two or three 300-to-400-MW thermal power plants in Galicia and to add two 300-to-400-MW thermal units to its power station at Escatron. All other expansion under the plan will consist of nuclear power plants. Spain's electricity companies are prepared to build 20 new nuclear stations by. 1982, adding around 14,000 MW to the country's generating capacity. Each station will cost $200 to $230 million and will use 250 to 350 closed process control loops. Nuclear power plants should account for 20% of installed generating capacity by 1978, and further expansion should raise that share to nearly 50% by 1990.

The first Spanish nuclear power station, built around a pressurized light water reactor, began producing 160 MW of electricity for Union Electrica's customers in 1969. The second nuclear plant, using a boiling water reactor, was completed in 1972; this 460-MW facility belongs to Nucleonor S.A. The only other nuclear power station operational in mid-1974 was constructed at Vandellos as a joint venture of Hifransa and Electricite de France. This 480-MW plant has a gas-cooled, natural uranium-graphite reactor.

Plans for nuclear power stations rely heavily on U.S. technology. Most of them will use light water reactors with enriched uranium fuel and will feature overlapping signals in the control and safety shutdown circuits. Spanish generating stations will probably use on-line computers to log data, recognize emergency conditions, and perform interlock functions such as blocking control rod withdrawal. The most important types of process control instruments needed include:

- Scalers
- Microammeters
- Amplifiers
- Power level indicators
- Gamma monitoring instruments
- Water analysis instruments to measure pH, electrolytic conductivity, dissolved oxygen, hydrogen and carbon dioxide, dissolved and suspended solids, boric acid, chloride and fluoride ion concentration
- Pneumatically operated valves

Iberdeuro S.A. is constructing a 950-MW nuclear power station at Lemoniz, Vizaya, that is typical of the large, new plants to be built in Spain over the next decade. The process control system will use primarily individual electronic analog controllers in a central control room. Approximately 350 closed loops will be provided, including 150 to 180 for the control rods and 25 on each of the two boilers. Well over 1,000 measuring channels, especially temperature sensors, will be installed. Computers will be used for data/alarm logging, logic functions, and emergency systems. The more advanced process control instrumentation built into the system will include on-line water analyzers, liquid waste analyzers, and nucleonic instruments for measuring count rate, period, linear power level, and external gamma radiation.

Organic chemicals sector.—Chemical processing ranked as one of Spain's largest industries in 1972, when sales surpassed $4.7 billion. Of the industry's 7,830 establishments, 95% had fewer than 100 em-

Table 4.—Spain: Number of establishments by industry and employment size, 1972

Industry	Number of Establishments Over 500 employees	101-500 employees	Less than 100 employees
Natural gas liquids	2	1	0
Food processing [1]	26	180	3,958
Paper and board	8	58	197
Chemical processing	35	351	7,444
Petroleum	4	5	0
	Over 5,000 employees	1,001-5,000 employees	Less than 1,000 employees
Primary metals	4	18	288
Electricity sector	3	10	8

[1] Does not include beverage sector.
Source: Bureau of International Commerce market research study.

ployees and 35 plants had more than 500 workers. Production of the 10 leading companies in 1972 was valued at nearly $1.3 billion, of which 67% came from Spanish-owned firms, particularly Union Explosivos Rio Tinto S.A., Repesa S.A., and Empresa Nacional Calvo Sotelo S.A.

Spain's chemical processing industry has a high degree of foreign participation. American corporations are probably the leading investors, having acquired minority shares of a large number of Spanish chemical plants. Two U.S. subsidiaries, Dow Unquinesa S.A. and Monsanto Iberica S.A., were among the top 10 chemical producers in 1972 and accounted for 2% of industry output. BASF and Hochst of Germany also have large subsidiaries in Spain.

The Spanish Government views chemical industry expansion as critically important in broadening the country's industrial base. The Third Development Plan calls for expenditures of over $1 billion during the 1972-75 period to develop production—rather than transformation—of chemical products, and to increase the average size of chemical plants. Out of capital investments totaling $239 million in 1972, the industry spent $11.8 million for process control instruments. It expects to increase that amount by nearly 6% annually to reach more than $16 million in 1978. Investment in the basic chemical sector totaled $113 million in 1972 and is expected to reach $157 million in 1975.

The fastest growth is foreseen in the organic chemicals sector, where production reached almost $262 million in 1972. Output of the 15 most important organic chemicals totaled 790,000 metric tons (MT), including 130,000 MT of ethylene and 106,000 MT of formaldehyde. By 1976, production capacity is expected to nearly triple 1972 output.

A large number of projects are planned for the 1975-76 period in the organic chemicals sector. Union Explosivos Rio Tinto intends to build at least four new plants to increase their output of dimethyl-terephthalate, styrene monomer, acetone, phenol, and urea (see table 6). Interquisa expects to spend $50 million for a 95,000-MT dimethyl-terephthalate plant, and Dow Unquinesa plans to build a new formaldehyde plant. A $50-million ethylene plant will be constructed by Empresa Nacional de Petroleos de Tarragona S.A., and Empresa Nacional Calvo Sotelo has started work on one of three proposed plants at Puertollana.

Table 5.—Spain: Planned generating capacity 1973, 1977, 1980, and 1983

(in thousands of megawatts)

Type of Station	1973	1977	1980	1983
Conventional hydroelectric	10.9	12.1	13.2	13.2
Pumping/storage schemes	0.5	2.8	4.0	5.2
Coal stations	3.8	5.2	5.2	5.2
Fuel-oil fired	6.1	8.6	8.6	8.6
Gas turbine	0.2	0.4	0.9	1.5
Nuclear	1.0	2.8	8.0	15.0
Total	22.5	31.9	39.9	48.7

Source: Bureau of International Commerce market research study.

The concept of continuous process plants with large throughput and centralized control rooms is being adopted by Spanish chemical producers, and the use of electronic analog controllers is increasing fairly rapidly. A few supervisory control computers have been installed, but there had been no reported use of direct digital control by mid-1974. Digital systems are employed primarily for multipoint temperature indicators. The use of on-line composition analyzers is increasing, although they are regarded as expensive. The heaviest demand over the next 5 years will probably be for the following process control instruments:

- Air and water pollution continuous monitoring instruments; e.g., smoke density and sulfur dioxide analyzers
- pH meters
- Conductivity meters
- Turbidity meters
- On-line chromatographs

Spain's largest ethylene plant, capable of producing 260,000 tons per year, is operated by Empresa Nacional Calvo Sotelo at its Puertollano site. The process control system is based on individual pneumatic analog controllers and has 300 to 325 closed loops. Some on-line analyzers have been installed, but no digital instruments are used.

Blast furnace and basic steel mills sector.—Spain's primary metals industry comprised some 300 establishments and approximately 150,000 employees in 1973. Another 246 companies, operating 254 plants and employing 138,500 persons, were active in the basic iron and steel sectors. Sales turnover for the entire industry totaled $3.1 billion in 1972 and capital investment amounted to $333 million. Purchases of process control instruments topped $13 million in 1972 and are predicted to reach nearly $16 million in 1978.

Output of the blast furnaces and basic steel mills sector in 1972 was valued at $1.5 billion and totaled 30.9 million tons, divided as follows: steel, 9.5 million tons; steel equivalent rolled products, 8.8 million; hot rolled products, 6.7 million; and pig iron, 5.9 million. Half of Spain's steelmaking capacity belongs to one giant State-owned company formed by the recent merger of Empresa Nacional Siderurgica (ENSIDESA) and Union Siderurgica Asturiana (UNINSA). This enterprise accounted for 39% of the sector's sales in 1972. Approximately 24% of sales were attributed to the second largest steelmaker, Altos Hornos de Vizcaya (AHV), a private firm.

Foreign investors played a very minor role in

Table 6.—Spain: Selected projects in organic chemicals sector planned for 1975-76

Company	Location	Product	Plant Capacity in tons per year	Cost in $ million
Paular S.A.	Puertollano	Acrylonitrile	Upgrading to 60,000	n.a.
Rio Gulf Petroquimica	Huelva	Cyclohexane	Upgrading to 40,000	n.a.
Union Explosivos Rio Tinto	Tarragona	Dimethyl-terephthalate	50,000	10.0
Union Explosivos Rio Tinto	Tarragona	Phenol and acetone	30,000 (phenol)	7.0
Union Explosivos Rio Tinto	Tarragona	Styrene monomer	100,000	11.0
Union Explosivos Rio Tinto	Huelva	Urea	150,000	n.a.
Induquimica	San Rogue	Methanol	200,000	12.5
Induquimica	Algeciras	Phthalicanhydride	20,000	5.8
Empresa Nacional de Petroleos de Tarragona S.A. (ENTASA)	Tarragona	Butadiene	43,000	n.a.
ENTASA	Tarragona	Ethylene	325,000	50.0
ENTASA	Tarragona	Propylene	127,000	n.a.
Empresa Nacional Calvo Sotelo	Puertollano	Methylethylketone	100,000	n.a.
Empresa Nacional Calvo Sotelo	Puertollano	Benzene	75,000	n.a.
Interquisa	Algeciras	Dimethyl-terephthalate	95,000	50.0
Interquisa	Algeciras	Terephthalic acid	95,000	n.a.
Bayer Hispania Industrial	Tarragona	Isocyanates (MDI/TDI)	Upgrading to 24,000	5.5
ERTISA	Huelva	Methylamines	n.a.	9.5
Union Quimica del Sur	Algeciras	Methylamines	6,000	5.0

Source: Data based on European Chemical News "Chemoscope," March 1974; Hydrocarbon Processing, February 1974; Ingeniera Quimica, December 1973.

Spain's basic iron and steel industry. United States Steel owns 28% of AVH and 15% of Altos Hornos del Mediterrane, probably one of the top five steelmakers in Spain. Crucible Steel has a 2% share of Patricio Echevarria, the 12th largest steel company. Krupp of Germany holds a 4% interest in UNINSA. The only other significant foreign investment comes from a Japanese consortium headed by Nisshin Steel, which is building a 500,000-ton steelworks in the Campo de Gibraltar area.

One aim of the Spanish Government is to satisfy internal demand for steel with domestic production. During the 1964-70 period, nearly $1.4 billion was invested in the iron and steel industry, and a similar amount has been budgeted for the years 1971 through 1975. Steel production increased 13% from 9.5 million tons in 1972 to 10.8 million tons in 1973. A goal of 12.19 million tons has been set for 1975, when consumption is expected to reach 12.17 million tons. The domestic market for steel is predicted to rise an average 7.4% annually between 1975 and 1982, and the Fourth Development Plan is expected to give priority to enlargement of the country's steel output.

Expansion plans already announced include the construction of Spain's fourth integrated steelworks, which will use the same process (blast furnaces with oxygen converters) as the other three. The first phase of this new steelworks, built by Altos Hornos del Mediterrane, will be completed by 1975 at a cost of $380 million, and the second phase should be finished by 1978.

Construction has begun on two of four proposed direct reduction minimills. These plants, each capable of producting 500,000 tons of carbon steel a year, should all be operational by 1978. A special steelworks will be built at Irurzun by Jose-Maria Aristrain S.A., and Olarra S.A. intends to erect a new tube mill at Sanguesa.

Many of the steelmaking companies plan to modify and expand existing plants to increase production capacity. For example, Altos Hornos del Mediterrane has ordered a spent acid regeneration plant with a capicity of 12,000 liters per hour. Altos Hornos de Vizcaya has just completed the first stage of a project to enlarge its blast furnace at Sestao.

Spain's steelmakers are moving toward larger and more sophisticated establishments and are relying more heavily on process control instruments. Nearly 64% of total steel output by 1975 will come from plants capable of producing more than 2 million tons annually. Special steel, about 4,5 milion tons annually, will be produced in electric arc furnaces using a continuous casting method. New direct reduction steelworks will probably be built around U.S. designs, either the HyL method or the Midland Ross Midrex process. The highest demand during the next 5 years is forecast for items such as:

- Thermal conductivity analyzers
- Paramagnetic infrared analyzers
- On-line chromatographs
- Gas analyzers to measure oxygen, hydrogen, carbon dioxide/monoxide, and methane in waste and reducing gases

- Nucleonic instruments to monitor level of molten steel
- Nucleonic instruments for weighing and measuring thickness
- Roll speed control devices
- Roll force measurement instruments

The process control system used at the Baracaldo steelworks is typical for large integrated plants. This establishment, owned by Altos Hornos de Vizcaya can produce 2.2 millions tons of steel per year and includes a sinter plant, coke ovens, blast furnace with three stoves, L-D converter, a water treatment plant, and two boilers. The processing system is controlled by 150 to 200 closed loops monitored from separate panels, one for each plant. Individual analog controllers are used. The more advanced instrumentation includes oxygen meters, smoke analyzers, and humidity meters.

Duties and Trade Regulations

A common external tariff (CET) ranging from 1 to 27.5% is applied to process control instruments entering Spain from any country except the six original EEC members. Goods imported from France, Germany, Belgium, Luxembourg, The Netherlands, and Italy are taxed at a preferential rate that amounted to 90% of the CET in 1974. This rate will be further reduced in 5% increments until it reaches 75% of the CET in 1977. Negotiations are underway to extend similar tariff concessions to the United Kingdom, Ireland, and Denmark. In addition to the customs duty, Spain imposes a Home Compensation Tax ranging from 5 to 12% of the c.i.f. value plus the import duty. Information on specific duty rates may be obtained from the U.S. Department of Commerce, Domestic and International Business Administration, Room 4012, Main Commerce Building, Washington, D. C. 20230.

Spain's dependence on imports has resulted in acceptance of a variety of technical standards, primarily those of the United States, United Kingdom, France, and Germany. Unidad de Normas Espanolas recently appointed a committee to establish Spanish standards. Those already issued have been modeled on Deutsche Industrie Normen of Germany, and none of the standards applicable to process control equipment has become mandatory. For further information, contact the Instituto Nacional de Racionalizacion del Trabago, Sorrano 150, Madrid 6, Spain, or the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

The following market research survey is available on loan from the U.S. Department of Commerce, Domestic and International Business Administration, Room 1063, Main Commerce Building, Washington, D.C. 20230:

"The Spanish Market for Process Control Instrumentation," DIB 74-12-514, August 1974.

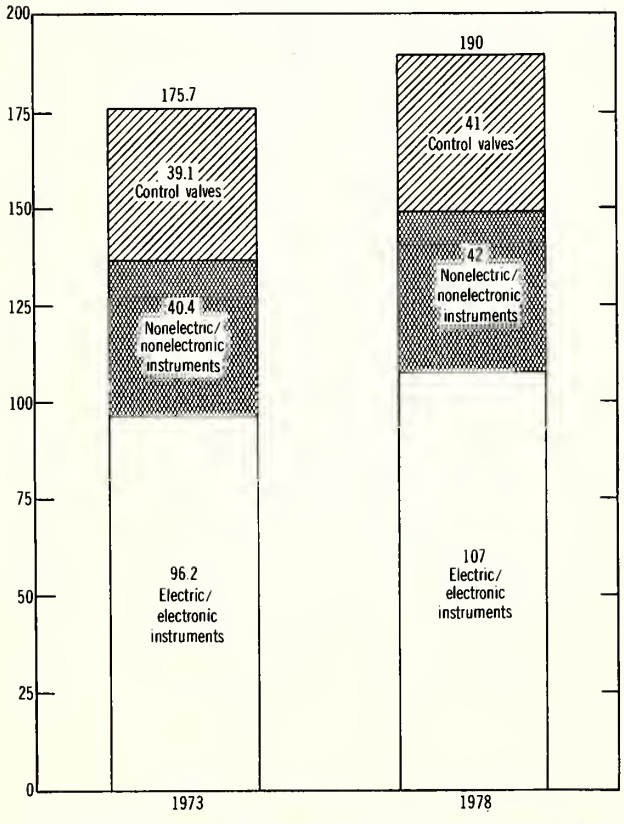
United Kingdom

The United Kingdom, one of the world's most industrialized and technologically sophisticated nations, has a high level of demand for process control instrumentation. Sales of this equipment fluctuated between $165 and $176 million annually during the 1970-73 period (see table 1). Products of American design continue to dominate the market and should supply a major portion of the $190 million in sales projected for 1978.

Of the sales of process control instruments to U.K. firms between 1970 and 1972, about 65% were *electric/electronic*. Mounting investments in the primary metals and utilities industries, which use predominantly electronic systems, raised this proportion to 70% in 1973, a level that will probably be sustained through 1978. Sales of electric/electronic instruments advanced accordingly, increasing from $86.9 million in 1970 to $96.2 million in 1973, representing a growth rate of nearly 3.5% a year. The market for this equipment is projected to reach $107 million in 1978.

United Kingdom: Size of market for process control instruments, 1973 and projected 1978.

(in millions of U.S. dollars)



Source: Bureau of International Commerce, Office of International Marketing research study. Values based on United Kingdom trade source estimates.

Purchases of *nonelectric/nonelectronic* instruments declined an average of almost 4.5% per year from 1970 to 1973, reflecting a temporary slump in capital investment in industries, such as chemical processing, that are heavy users of these devices. Sales dropped from $46.6 million to $40.4 million but were expected to show a gradual increase after 1973, totaling an estimated $42 million in 1978.

The U.S. market for *automatic control valves* reached an unusually high level of $41.9 million in 1970, boosted considerably by construction of the national methane distribution network. Sales returned to the $36.5-million level in 1972, then increased 7% to $39.1 million in 1973. Future demand for these products, particularly from the growing primary metals and utility services industries, should sustain this market and increase consumption to almost $42 million in 1978.

U.S. producers leading suppliers.—U.K. manufacturers import approximately 20% of their process control instrumentation, with the major share coming from the United States (see table 2). The strong preference for American-made products is based on their reliability and a long history of successful applications. British consumers have been particularly impressed with the superior design of such recently

United Kingdom—Selected Indicators (1973)	
Gross national product:	$170 billion
Population:	55.8 million
Total country imports:	$44 billion
Total country exports:	$39 billion
Exchange rate (September 1974):	Fluctuating at about .42 pounds = US$1

developed U.S. items as turbidimeters and liquid-filled pressure gages.

The dominant market position of American-made process control instruments is also reflected in the strength of such well-established U.S. subsidiaries as Foxboro-Yoxall Ltd., which has been operating in the United Kingdom since the mid-1930's. Except for the George Kent Group, the largest domestic manufacturers of process control equipment are U.S. subsidiaries and licensees: the 14 largest U.S. firms, ranging in size from 120 to 2,600 employees, account for roughly 55% (an estimated $116 million in 1970) of total industry output. Altogether, 64 U.S.-owned companies or licensees, employing a total of over 15,000 persons, are active in the British Isles. All of the major U.S. process control instrument producers are represented by plants that manufacture and/or assemble product lines, and import parts and more out-of-the-ordinary items.

The leading domestic suppliers of U.S.-designed pneumatic, electric, and electronic process control instruments are Taylor Instrument Companies (Europe) Limited, Foxboro-Yoxall Limited (of the Foxboro Company), and Honeywell Limited-Industrial Products Group, all direct subsidiaries. The chemical processing and petroleum industries' markets have recently been penetrated by Westinghouse Electric International with its Veritrak equipment, and by Leeds and Northrup Limited, which also sells to basic steelworks and steel foundries. Two other firms, Rosemount Engineering Company Ltd. and Bell and Howell, Electronics and Instruments Group, are challenging the leaders with new transmitter designs. Another U.S. subsidiary, Fischer and Porter Ltd., has recently entered the market in the chemical processing and utility services industries.

The largest producer of automatic control valves in the United Kingdom is GEC-Elliott Control Valves Ltd., a licensee of two U.S. companies, Fisher Controls Company and Farris Engineering (Teledyne). GEC-Elliott supplies modulating valves for the paper and board industry, control valves for the chemical processing and petroleum industries, pressure governors for the gas industry, and other control and regulator valves for the electricity sector and the water and sewage treatment services. J. Blakeborough and Sons Ltd., a licensee of ITT-Hammel Dahl, and Masoneilan Ltd., a U.S. subsidiary of Masoneilan International, Inc., are major suppliers of valves to the chemical processing and petroleum industries.

Domestic producers top competitors.—The seven largest British manufacturers of process control devices account for about 35% (an estimated $74 million in 1970) of the total domestic output. The industry includes some 160 other U.K. firms, many of them small companies manufacturing specialized products of their own design. An estimated one-third of process control instrument production in 1969 was exported.

The British-owned George Kent Group, which devotes 8 plants and 5,200 employees to manufacturing the entire range of process control instruments, is the largest producer of this equipment in the United Kingdom. Their "Flexel" electronic controller systems and Introl valves are highly regarded by all British user sectors. The second-largest British-owned firm, Bailey Meters and Controls Limited and its subsidiary, Digimatics Limited, are major suppliers to the utility services. Sensors for pressure, level, flow, temperature, and humidity are among the process control instruments produced by the Negretti and Zambra Group, which includes 3 plants with a total of 1,200 employees. KDG Instruments Ltd., with 450 employees, is known for its flow and pressure transmitters, often used in the power generation and gas sectors. However, in view of their high cost, the greater accuracy of these transmitters can only be justified in a few applications. The Budenberg Gauge Company Ltd., with 450 employees, manufacturers test, process, and general-duty pressure gages, and Delta Controls Ltd., with 200 employees, makes a variety of switches. Nuclear Enterprises Ltd. and Thorn Automation Ltd., though not among the leading firms, each produce about $1 million worth of process control instruments annually.

British-made process control instruments are preferred in certain industries, mainly food processing,

Table 1.—United Kingdom: Size of market for process control instrumentation, 1970, 1972 and 1973

(in millions of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments	86.9	86.6	96.2
Nonelectric/nonelectronic instruments	46.6	41.4	40.4
Automatic control valves	41.9	36.5	39.1
Total process control instrumentation [1]	175.4	164.5	175.7

[1] The above estimates include control room accessory equipment and primary elements such as orifice plates. The following items have been excluded: data loggers, telemetry, remote supervisory systems, and all spare parts for instruments or valves.

Source: Bureau of International Commerce, Office of International Marketing research study.

steel production, and the nationalized utilities. Some U.K. manufacturers of specialized instruments are protected from foreign competition by Government regulations. For example, open-channel water flow measurement devices must meet highly particularized local standards.

Third-country producers of process control equipment are represented in the United Kingdom by 24 manufacturers. Four of these subsidiaries, including Serck Controls, the second-largest valve manufacturer in the United Kingdom, are among the top 25 companies in the industry. Serck, with 550 employees, also produces electrochemical instruments under license from a Dutch firm, Electrofact.

Pye of Cambridge is a group of three companies manufacturing or marketing most of the process control and analytical instruments made by Philips Gloeilampen Fabrieken NV of the Netherlands. One of the group, Pye Dynamics, has taken over the designs of J. Langham Thompson transducers. Some 25% of the output of the three subsidiaries, with their 2,700 employees, comprises process control instruments.

Ronald Trist Controls Ltd., a subsidiary of Bestobell Limited, produces ball float switches under license from Mobrey of France and acts as a sales agency for several European and American companies. Drayton Controls Ltd., a subsidiary of Spirax-Sarco Engineering Ltd., with 550 employees, manufacturers pneumatic process control systems under license from JSP-Obsa of Italy.

Where U.S. producers supply the preponderance of imported process control instruments to U.K. consumers, certain specialized items are imported from other sources. Hartmann & Braun of Germany, the leading third-country supplier, has recently set up a sales and service center in Northampton. Composition analyzers are often purchased from German sources because of their low price. Consistency meters have been imported from Kalle in Sweden, and moisture meters have been purchased from HMB (Switzerland) and Lippke (Germany). Endress and Hauser (Germany) are quite well known for hopper level measurement and related devices. Pressure gages are supplied by A. Wiegand (WIKA) of Germany.

Except for the companies already mentioned, German, French, and Italian suppliers are generally important only for export contracts engineered in the United Kingdom: e.g., French instruments used in Algerian pipeline contracts. A few specialized instruments used in particular industries are imported from Denmark, Sweden, the Netherlands, and Switzerland. Future competition may come from Japanese companies, including U.S. subsidiaries; Yamatake-Honeywell equipment is already used in some U.K. installations.

Table 2.—United Kingdom: Imports of selected process control instruments by country of origin, 1970, 1971, and 1972.

(in thousands of U.S. dollars)

	1970	1971	1972
Instruments and apparataus for measuring, checking variables, gases, etc.: pressure gages, recorders, and controllers			
United States	1,670	1,579	1,193
Denmark	1,395	442	528
Germany	608	734	775
France	220	176	293
Other	860	849	1,087
Total	4,753	3,780	3,876
Instruments and apparatus for measuring, checking variables, of liquids, gases, etc.; flow-meters and controllers			
United States	1,828	1,713	1,159
Germany	493	515	499
The Netherlands	325	556	492
Kenya	210	102	36
Other	638	886	869
Total	3,494	3,772	3,055
Electrical measuring, analyzing, etc., instruments and apparatus; thermometers and pyrometers containing optical elements			
United States	84	56	101
Germany	10	10	7
Sweden	3	—	7
Denmark	5	7	—
Other	16	10	22
Total	118	83	137
Thermostats and thermoregulators			
United States	381	442	257
Germany	243	261	360
Italy	135	159	348
France	71	83	547
Other	468	490	662
Total	1,298	1,435	2,174
Electrical measuring, analyzing, etc., instruments and apparatus; telemetering instruments and apparatus			
United States	350	183	1,094
Germany	13	403	84
The Netherlands	8	51	17
South Africa	—	41	19
Other	155	93	134
Total	526	771	1,348

Source: Overseas Trade Statistics of the United Kingdom, based on data collected by H. M. Customs and Excise.

Major Industrial Users

Research conducted in the United Kingdom for the U.S. Department of Commerce, Office of International Marketing, identified and surveyed seven industries that account for roughly 75% of the process control instruments purchased annually (see table 3). Total sales of these selected industries

Table 3.—United Kingdom: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Estimated Sales 1972	Capital Investment 1972	Process control instrumentation consumption 1972	1978
Natural gas liquids	n.a.	20 [1]	1.7	1.9
Food processing [2]	14,090	391	2.5	3.8
Paper and board	1,330	49	1.7	1.9
Chemical processing	10,065	762	39.5	38.0
Petroleum	3,505	270	13.2	11.4
Primary metals	9,770	695	23.0	34.2
Utility services	7,185 [3]	1,850 [3]	42.8	55.1

[1] Estimate.
[2] Does not include beverage processing.
[3] 1971 figures.
Source: Sales and capital investment data based on *Business Monitor*, 1972, Provisional Report on the Census of Production, and the United Kingdom annual Abstract of Statistics; consumption of process control instrumentation data based on trade source estimates.

reached nearly $46 billion in 1972; capital investment exceeded $4 billion, with $124 million spent for process control instruments. Trade sources predict that the combined process control equipment purchases of these seven industries will surpass $146 million in 1978. Three sectors offering particularly good sales opportunities to process control instrument manufacturers over the next 5 years have been identified.

Electricity generation and distribution sector.—Process control instrument sales to the U.K. utility services industry are expected to grow more than 5.2% annually between 1972 and 1978, with the largest demand coming from the electricity generation and distribution sector. The Government is investing heavily in plant expansion and new construction in this nationalized industry, as evidenced by capital expenditures exceeding $1.8 billion in 1971, when sales totaled almost $7.2 billion. All sectors combined, except the sanitary services sector, employed over 366,000 workers in 1970, distributed among some 71 establishments (see table 4).

The Central Electricity Generation Board (CEGB) is responsible for electricity generation in England and Wales. Generation and distribution of electricity in Scotland and Northern Ireland are handled by three local boards: the South of Scotland Electricity Board (SSEB), the North of Scotland Hydroelectricity Board (NSHEB), and the Electricity Board of Northern Island (EBNI). Altogether, this sector employed almost 206,000 persons and had sales totaling $4.8 billion in 1971. Output capacity of the entire sector grew from 65,600 megawatts (MW) in 1971 to 68,800 MW in 1972, while maximum demand was increasing from 44,900 MW to 48,800 MW. Net capital expenditure for the sector reached $1.2 billion in 1971, including $985 million for plant and machinery. Investment in process plant items grew an average 24% annually, rising from $112 million in 1971 to an estimated $212 million in 1974.

The CEGB, SSEB, and NSHEB are striving to achieve a better balance among the different fuels—coal, oil, natural gas, and nuclear energy—used in electricity generation. Coal-fired power stations presently predominate, and most new stations are oil-fired or dual-fired by coal and oil. The CEGB has 10 nuclear stations operating, 5 under construction, and 9 more planned. The SSEB has two nuclear stations in Scotland.

The CEGB is building two oil-powered stations, scheduled for completion in 1978. The station at Ince "B" Elton, Cheshire, costing $275 million, will have two 500 MW units and 120 process control loops. The station being built at Isle of Grain, Kent, at a cost of $900 million, will have five 600 MW units and use approximately 300 control loops. This plant will also have seven computers, one for each generating unit and two for substation and station common services. The total number of input signals for the complete Grain station is likely to range from 8,000 to 10,000.

Four oil-fueled, 660 MW units, using 220 control loops, are being built by the SSEB at Inverkip, Renfrewshire; the first unit is scheduled for completion in late 1975. The NHSEB is building an oil and gas-fueled power plant with two 660 MW units and 120 control loops at Peterhead, Aberdeenshire. This installation should be completed by 1979 at a cost of $250 million.

Parliament has authorized the construction of several more plants by the CEGB, including three new oil-fueled power stations (see table 5). SSEB plans to build a 2,600 MW station at Boness, W. Lothian, and EBNI is planning two new plants, at least one of which is to be powered by oil.

Each of the five nuclear power stations being built by the CEGB is expected to cost around $300 million and to generate 1,300 MW through a pair of 660 MW generators. Future CEGB nuclear power station sites now being discussed include Portskewett (1,300 MW), Oldbury B. (650 MW), and Size-

well B (2,640 MW). The SSEB has already applied for permission to build two 2,600 MW nuclear stations, to begin operating in the 1980's, and a single nuclear station to serve the whole of Ireland is under consideration.

The CEGB wants to order nine twin reactor nuclear stations by 1979, including some or all of the proposed plants discussed above. Three reactor designs are being considered: the American LWR, the Canadian CANDU, and the British SGHWR. Some members of Parliament prefer to "buy British," but the final choice must satisfy the safety requirements of the Nuclear Installations Inspectorate. An experimental 250 MW fast breeder reactor at Dounreay (North of Scotland) began production of power during the first half of 1974, but it will be many years before large-scale units of this type are built.

The prospective developments in the electricity generating and distributing sector should provide excellent sales opportunities for process control instrument manufacturers. Power station boilers in the United Kingdom work very close to the design limit of the construction materials used (2,700 pound-force per square inch (lbf/in^2) and 370°C), which necessitates the use of very sophisticated control systems, with many measuring points duplicated or triplicated. Electrical transmission of signals is employed throughout the sector. Nuclear power plants have quite complex safety controls that are used to monitor neutron flux density, distribution, and contours. Signals from these monitors also require on-line computer analysis. The process control instruments in greatest demand by this sector include:

- Nonfallible direct-viewing boiler water level gages
- Viscometers
- On-line analyzers
- Feedwater analyzers to measure pH, conductivity, dissolved oxygen, and hydrazine content
- Steam/condensate analyzers to measure pH, conductivity, dissolved oxygen, and silica content
- Direct digital controls
- Solid-state logic modules
- High-pressure valves

The Kingsnorth Power Station, Kent, England, one of the CEGB's most efficient dual-fired power stations, provides a good example of a large British process control system. Fired by both coal and oil, the plant has a capacity of 2,000 MW divided among four units, plus an auxiliary boiler and services. The control system has an estimated 250 closed loops, including those for services and auxiliaries, and about 10 analyzers per boiler. Electronic analog transmission (4-20 milliamperes) to a central room enables an operator to run the system through thyristor-controlled electric actuators. Some of the more advanced instrumentation used in this plant includes solid-state annunciators for plant alarms, plus separate graphic diagrams for the fire alarm system; a large data logging computer; and nearly 2,000 individual electric motor (on-off and three-position) damper actuators.

Table 4.—United Kingdom: Number of establishments by industry and employment size, 1970.

Industry	Number of Establishments: Large (1,000 or more employees)	Medium (100-999 employees)	Small (1-99 employees)
Natural gas liquids	3	8	—
Food processing [1]	65	688	3,661
Paper and board	16	134	113
Chemical processing [2]	26	177	495
Petroleum (1971)	6	16	3
Primary metals	101	581	2,094
Utility services [3]	27	7	37

[1] Does not include beverage processing.
[2] Industrial inorganic chemicals manufacturing, drug manufacturing, and industrial organic chemicals manufacturing sectors only.
[3] Does not include sanitary services sector.
Source: Data based on *Business Monitor;* Census of Production 1970.

Industrial organic chemical manufacturing sector.—The chemical processing industry accounted for nearly 25% of all the process control instrumentation purchased in the United Kingdom in 1972. The largest demand for these products came from the industrial organic chemicals manufacturing sector, which provides high tonnage basic feedstocks to most of the remaining sectors and operates the major portion of the large processing units used by the industry.

The U.K. chemical processing industry as a whole comprised 2,793 establishments in 1968, with 83 firms having over 1,000 employees. A total of 475,000 persons was employed in 1970. The total output of the 20 leading chemical companies, including conglomerates with interests outside the chemical industry, exceeded $10.7 billion in 1973. Of this output, 14% was produced by U.S.-owned companies, 67% by U.K.-owned firms, and 19% by other foreign-owned concerns. The major U.S. subsidiaries in the U.K. chemical processing industry are Esso Chemical Ltd., Monsanto Textiles Ltd., DuPont United Kingdom Ltd., and Union Carbide U.K. Ltd. Imperial Chemical Industries Ltd. (ICI), Courtaulds Ltd., and British Oxygen Company Ltd. (BOC) are the leading British-owned producers. The largest foreign (other than U.S.) subsidiaries are Shell Chemicals U.K. Ltd. and Unilever Ltd., both of the Netherlands.

The industrial organic chemicals manufacturing sector in 1970 consisted of 103 companies, with a total of 39,500 employees. Five plants had more than 1,000 workers. The three largest companies accounted for 63% of total sales, which reached $1.5 billion in 1970. Capital investment for the

Table 5.—United Kingdom: Typical new power stations under construction.

Controlling Board and Plant Location	Capacity	Fuel	No. of Control Loops (est.)	Planned Dates (Known)
CEGB				
Killingholme, Lincs.	4,000 MW	Heavy oil	—	Consent granted, July 1972
Littlebrook 'D' Dartford, Kent	2,000 MW (3 x 660 MW)	Oil	175	Construction approved, 1973
Brunswick Wharf B, London E14	900 MW	Oil	100	—
Inswork Point, Cornwall	1,320 MW (2 x 660 MW)	Oil	120	Consent granted, August 1973
W. Burton 'B' Retford, Notts.	2,000 MW	Coal	—	Consent granted, August 1973
Dinorwic, Carnarvonshire N. Wales	1,500 MW	Pumped storage hydro	—	Completion, 1980
SSEB				
Boness, W. Lothian	2,600 MW (4 x 660 MW)	—	250	Completion, mid-1980's
EBNI				
Ballylumford, N. Ireland	960 MW	—	—	—
Kilroot	1,200 MW	Oil	—	—

Source: Data based on the *Electricity Supply Handbook* and CEGB Information Services.

sector in that year totaled more than $300 million. The total output of 13 basic chemicals in 1972 exceeded 3.7 million metric tons (MT), including 1.1 million MT of ethylene and 60 million proof gallons of industrial ethyl alcohol.

The number of new plants completed during 1972 in the organic chemicals sector was substantial. Expenditures in the 1973-75 period would be mainly for extensions, modifications, and improvements rather than for major new plants. Nonetheless, construction on a new ethylene plant, a joint project of ICI and British Petroleum Chemicals Ltd. (BP), is expected to begin in 1977. The plant will cost approximately $50 million and will be capable of producing 500,000 tons per year. The process control system is expected to have about 400 loops.

ICI announced that its total capital investment in 1974 would exceed $250 million and will probably be higher in subsequent years. Production capacity at the Billingham/Teeside complex will be enlarged for several products: protein concentrate will be increased by 100,000 tons per year; alcohol and ketones (plasticizers) by 50,000 tons; and methylamines by an undisclosed amount.

Synthetic Chemicals of Knottingly, Yorkshire, was to augment its production capacity of p-Cresol by 5,000 tons (at a cost of $2 million) and of para-ethylphenol by 1,000 tons, beginning in 1974. Orsi intends to build a plant, starting in 1975, to produce 80,000 tons of propylene yearly at Hunterston, Scotland.

Shell Chemicals is building a new plant at Stanlow, Cheshire, with a benzene production capacity of 450,000 tons, and another plant at Carrington with an annual capacity of 100,000 tons of ethylene. Designs for further organic processing units at Carrington have been considered, but it is not yet known which will actually be constructed.

Aside from the joint ICI-BP project, BP has four or five other organic chemical projects under consideration involving extension and modification at the Grangemouth site. The eventual construction is expected to cost some $120 million.

Other plans for new plants based on feedstocks derived from North Sea oil or gas are likely to be announced within the next year or two. For instance, Dow Chemical has a long-term plan of this nature, but the location of the plants has not yet been decided.

The chemical industry, and the organics sector in particular, is well known for large, integrated plants. There is widespread use of central control rooms for regulating a series of processing units belonging to one or more plants. The fact that nearly all organic plants involve continuous processes with interlinked units has led to intensive use of process control instruments. At the same time, the degree of control possible for individual analog controllers is limited by the interaction beween different loops, plant variables, and processing units. Thus, various forms of computer supervisory control working through individual analog instruments have been developed. Computers are also used for alarm logging and post-incident recording.

Products expected to continue in high demand

in the industrial organic chemicals manufacturing sector include the following:

- On-line chromatographs
- Oxygen analyzers, particularly the null balance paramagnetic type
- Infrared gas analyzers
- Transducers
- Transmitters for the basic variables, especially flow
- Pneumatic control valves
- Modulating electric and electrohydraulic actuators

ICI Petrochemicals Limited in Wilton, Yorkshire, England, ICI's largest olefins plant to date, can produce 450,000 tons per year of ethylene, propylene, etc. The large process control system, with 350-400 closed loops, includes individual analog controllers, electronic controls on the cracking furnaces, pneumatic controls on the distillation units, and a central control room to monitor all operations. Oxygen analyzers are used on the furnace flue gas stacks, and three infrared gas analyzers and several chromatographs monitor composition at furnace exits and measure the constituents of the final product. A computer is used mainly on supervisory routines, with a few critical loops on direct digital control, and one program for optimization.

Blast furnaces and basic steel mills sector.—The primary metals industry in the United Kingdom expects to increase its purchases of process control instruments by over 6.8% a year between 1972 and 1978. The blast furnaces and basic steel mills sector alone spent $55 million on process plant items in 1970 and another $98 million in 1972, and is expected to invest $170 million in 1976, an average annual expansion rate exceeding 20% over the 6-year period.

Basic iron and steelworks in the United Kingdom are almost entirely owned by the British Steel Corporation (BSC). The Corporation operated 46 iron and steelworks and 62 blast furnaces in 1972. Out of the 281,600 employees in all U.K. steelworks and steel foundries in 1970, BSC had 252,400. BSC accounts for 80% of all U.K. steel deliveries, including imports; the completely British-owned private sector accounts for the remaining 20%.

Capital investment in basic iron and steelworks and steel tube manufacture in 1972 reached $550 million, with $440 million expended for plant and machinery. Sales in that year totaled $5.9 billion, and production amounted to 15.3 million MT of pig iron and 25.3 million MT of steel ingots and castings.

BSC's overall strategy includes the investment of $7.5 billion from 1973 through 1982 for the construction, expansion, and modernization of basic steelworks at six major sites, and the closing or converting of smaller plants. Five special steel division plants were to be modernized at Rotherham, Yorkshire, starting in October 1974. Additions will include an electric arc melting shop with a capacity of 400,000 tons per year at a cost of $20 million, a $55-million Thrybergh bar mill, and computer control of 28 soaking pits, using 200 direct digital control loops ($500,000).

BSC hopes to start on stage two of a complete new steelmaking complex at Redcar, Yorkshire, in 1975. The corporation will invest approximately $125 million in an ore terminal, sinter plant, pelleting plant, coke ovens, blast furnace, and power station.

The Ravenscraig Works at Motherwell, Scotland, are being upgraded to achieve a capacity of 3 million MT per year by 1976. The improvements are expected to cost $165 million and will include 35 coke ovens, a sinter plant, continuous slab casters with 50 closed control loops, and a water treatment plant. The blast furnace will be upgraded, adding 25 process control loops, and a 125-ton BOS converter with 20 closed loops will be installed.

The development of the basic oxygen furnace (BOF) (LD converter) was generally adopted by BSC some years ago. Continuous casting machines were incorporated in the Anchor project at Scunthorpe and are being installed in other works. BSC is not likely to adopt direct reduction techniques for some years, and most of the latest process developments relate to computer control. The particular types of process control equipment likely to be in demand for new steelworks include:

- Supervisory and direct digital control
- Paramagnetic, infrared, and chromatographic gas analyzers
- High-temperature probes
- Nucleonic equipment for level of molten steel, density measurement, and weighing and gaging thickness of steel strip and coatings

Several process control systems are used at the RTB works at Llanwern, Newport, one of BSC's six major sites. The steelworks complex has a yearly capacity of 3 million metric ingot tons. One plant uses a large system of individual electronic analog controllers with optional links to a supervisory computer to control a battery of 10 soaking pits (furnaces). There is one cubicle panel in a pressurized cabin for each pair of furnaces. The set point of the individual electronic controllers can be reset by computer, and there is automatic range change on combustion air flow (two transmitters). The 70-loop control system includes cascade and ratio loops.

The same steelworks includes a medium-size process control system in the strip-pickling and acid-regeneration plant. Here the 45 closed loops are monitored by individual electronic analog indicating controllers, panel-mounted in a pressurized cabin. The system includes 24 electromagnetic-flowmeters and two twin-channel titrator analyzers with sampling systems to determine hydrogen chlo-

ride and ferrous chloride concentration; some acid-resisting valve bodies are constructed from solid carbon. A similar pickling line and acid-regeneration plant with the same type of instrumentation is being installed at BSC's Ebbw Vale Works.

Other sectors offering good sales opportunities.— Several other sectors are expected to invest substantial sums in process control instruments in the next 5 to 10 years. These include the primary nonferrous metals mills, the plastics and synthetics manufacturing, and the agricultural chemicals manufacturing sectors.

In addition, several sectors in the food processing industry, especially the dairy products, fats and oils, and miscellaneous food manufacturing sectors, should provide process control instrument manufacturers with good sales prospects through 1978. Industry-wide expenditures for such apparatus are projected to advance more than 7% annually between 1972 and 1978. Excellent sales opportunities may arise in the beverage preparation sector, which spent nearly $2.5 million for process control instrumentation in 1972. Soft drink preparation is expected to show the fastest growth within this sector during the next 5 years.

Recent discoveries of offshore oil are sure to have a long-term impact on the petroleum industry, and present investment commitments therefore are likely to be revised upward. Industry sources predict that as much as $14 million may be spent for process control machinery in 1978 as a result of these new developments. Four new refineries are already planned, but some of the most interesting prospects for process control equipment manufacturers will be associated with off-shore oil production platforms, pipelines, and shore terminals.

Excellent sales opportunities are expected to arise in the natural gas production and distribution sector over the next several years. Annual investment in process plants averages around $95 million per year for this sector, but new gas discoveries in the North Sea could heighten expenditures substantially. Plans have already been made to lay a new double 36-inch pipeline through Scotland to Northern England by 1978 and to install 8 to 10 compressor stations at intervals along the line.

The water supply and sanitary services sectors were reorganized in 1974 into a National Water Council with jurisdiction over all installations concerned with rivers: water storage, treatment, and distribution; and sewage collection and treatment. Twelve regional boards, with 45,000 employees, replaced over 1,000 separate authorities and companies. This reorganization has temporarily curtailed plant investment, but the demand for process control instruments in this sector should rise sharply when new regional plans have been formulated in detail.

Duties and Trade Regulations

Process control instruments imported from the United States are taxed at the full U.K. duty rate, which ranges from 7.2% to 19.2% on these items. The United Kingdom admits duty free all products from countries in the European Free Trade Area and the Commonwealth Preference Standstill Area (in general, underdeveloped countries and small islands). Preferential rates averaging about one-third the full rate are imposed on items from countries in the Commonwealth Preference Area, which includes Canada, Australia and Hong Kong. U.K. tariffs on goods from the European Economic Community are being reduced in stages, and by 1977 all products from these countries will be admitted duty free. Information on specific duty rates may be obtained from the Domestic and International Business Administration, U.S. Department of Commerce, Room 4212 Main Commerce Building, Washington, D.C. 20230.

Technical standards and regulations for process control instrumentation are complicated by the fact that most of the equipment purchased and manufactured in the United Kingdom is of U.S. design, yet a significant portion of it is exported (directly or indirectly) to Europe and elsewhere. The most important standards are published by the British

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on the United Kingdom to supplement this report is available on a continuing basis from:

Country Marketing Manager—United Kingdom
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: (202) 967-3713

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in the United Kingdom", DIB 74-08-507. June 1974. The Office of Export Development also has available a "Tarket Market Trade List: Process Control Instrumentation—United Kingdom" for $3.00 which identifies major prospective customers, protential agents and distributors, trade publications, and trade associations.

Standards Institution (BSI), 2 Park Street, London W1A 2BS, England; the British Approval Service for Electrical Equipment in Flammable Atmospheres (BASEEFA), Department of Trade and Industry, Harpur Hill, Buxton, Derbyshire, England; and the Oil Companies Materials Association (OCMA), Cecil Chambers, 86 Strand, London WC2, England.

In general, six electrical safety standards may be considered mandatory for most industries: BSI's P 1003:1964; BS 1259:1958; and BS 4683:1971/72; BASEEFA's SFA 3012:1972 and SFA 3004:1971; and OCMA's INP 2:1968. Conformity with other nonelectrical codes and standards may be commercially desirable but is not essential. Additional information on current standards and projected changes can be obtained from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

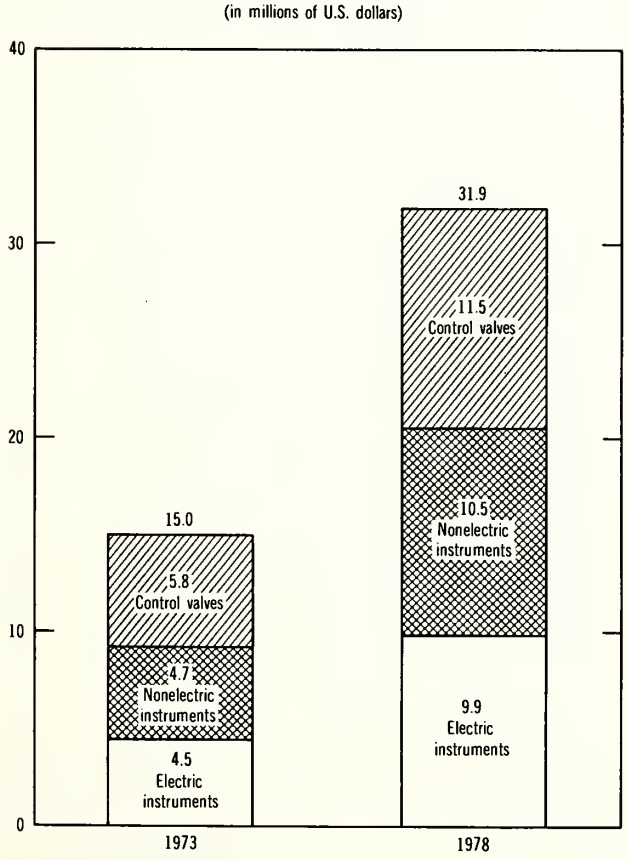
The most common American transmission range for analog 2-wire systems (4-20 mA dc) is fast becoming an international standard. However, the U.K. public utilities sector uses the British standard, and the CEGB specifies a range of 1-10 mA dc (2-wire) in accordance with this standard. Acceptable pneumatic signal ranges are 3 to 15 lbf/in^2. U.S.-owned user companies retain the traditional units of measurement such as pounds per hour, U.S. gallons, etc., but many organizations in the United Kingdom and Europe are changing to the International System of units (SI).

Venezuela

Fueled by rapid expansion of Venezuela's heavy industries, sales of process control instrumentation are forecast to grow by an average of 16.3% annually between 1973 and 1978. Government participation in and financial assistance to the primary metals and petrochemical industries, as well as public utilities projects, should help push the instrumentation market to almost $32 million by 1978.

Process instrumentation sales rose from $11.8 million in 1970 to $15 million in 1973, representing an average annual growth rate of 8.3% (see table 1).

Venezuela: Size of market for process control instrumentation, 1973 and projected 1978



Source: Bureau of International Commerce, Office of International Marketing research study. Values based on Venezuelan trade source estimates.

The trend toward increased mechanization in manufacturing will lead to greater demand for the more advanced process control instruments. Some of the larger operations are beginning to use computer-controlled systems. Demand for advanced instruments also will come from new construction in the petrochemical and primary metals industries. Some new plans, now on the drawing boards, are comparable in size to those in the United States and other highly developed countries and are expected to utilize modern instrumentation.

Between 1973 and 1978, sales of nonelectric instruments are expected to grow at a slightly faster average annual rate than those of electric instruments—17.4% as compared to 17.1%. The market for mechanical and pneumatic instruments is expected to exceed $10.5 million, while the level for electronic instruments should be almost $10 million in 1978. Sales of automatic control valves are forecast to total $11.5 million in 1978, representing a 14.7% average annual growth rate from the 1973 level of $5.8 million.

Imports from U.S. to double.—Venezuela depends on foreign manufacturers to fill most of its needs for process control instrumentation. Imports supplied 95% of the market in 1973 and are projected to account for 90% by 1978. The United States is the leading supplier (see table 2), with sales of $9.3 million in 1973, or 66% of imports. U.S. manufacturers by 1978 should hold a 64% share of the import market, representing sales of $18.7 million. Venezuelan purchases of U.S.-made automatic control valves in 1978 should total $8 million, or double the 1973 level of $4 million.

Venezuela—Selected Indicators (1973)

Gross national product (1972):	$13.1 billion
Population:	11.3 million
Total country imports:	$977 million
Total country exports:	$1,171 million
Exchange rate (March 1975):	US$1 = 4.26 bolivars

The United States is expected to supply over 50% of the market for mechanical and pneumatic instruments in 1978, with sales of $5.5 million. Trade sources report that U.S.-made electrical transmitters, controllers, and recorders have an excellent reputation in Venezuela, and sales of these items are expected to remain high. Imports of electronic controls are forecast to exceed $5 million in 1978.

Foxboro Co., Honeywell Inc., and Taylor Instrument Co. are the major U.S. manufacturers supplying the market. The ammonia and urea plants at the Moron complex use Taylor instruments, while Honeywell is the preferred supplier for the sulfuric acid plant. Another chemical company, Oxidor C.A., also uses Honeywell instrumentation. Siderurgica del Orinoco (SIDOR), the government-owned steel company, purchased instrumentation from Foxboro for its reduction plant at Puerto Ordaz. The petroleum industry primarily uses Foxboro, Honeywell, and Taylor instrumentation, although General Electric process control computers are used in the Amuay refinery complex owned by the Creole Petroleum Corporation. Other important U.S. suppliers include Bristol, Leeds & Northrup, Fisher Controls, and Anderson Greenwood International.

Some end-users purchase American instrumentation from U.S. subsidiaries in Venezuela. Taylor Instrument Co. has an assembly plant that accounts for 25% of its Venezuelan sales. Local production presently is limited to thermometers, but assembly operations will be expanded over the next 2 years to include electronic and pneumatic instruments. Bristol instruments are assembled by United Industrial Supply C.A. Empresas Norte-Sur S.R.L. of Maracaibo plans to begin assembly operations of Anderson Greenwood valves.

Other foreign firms hold one-third of market.—The George Kent Group (United Kingdom), Siemens and Hartmann & Braun (Germany), and Nuovo Pignone (Italy) are the major foreign manufacturers competing with U.S. firms in the Venezuelan market for process control instrumentation. Sales by foreign manufacturers other than U.S. firms accounted for 32% of the market in 1973. This percentage is expected to drop slightly to 31% by 1978.

A few major foreign suppliers have successfully penetrated the market. Some Italian-made instruments are used in the new ammonia and urea plants in the Moron complex. The older sodium chloride plant also uses Italian controls. Siemens has successfully introduced its instrumentation to the primary metals industry. Some instruments from Phillips (the Netherlands) and Kent have been purchased by Compania Shell de Venezuela. Trade sources report, however, that third-country suppliers are most competitive in small, manually operated instruments.

Local production is limited to small, manually controlled valves and temperature recorders, plus assembly of some imported parts. However, the Venezuelan Development Corporation (CVF) has commissioned a market study to determine the production feasibility of instruments for measuring and controlling temperature, pressure, and fluid flow.

Major Industrial Users

Research recently conducted in Venezuela for the U.S. Department of Commerce, Office of International Marketing reveals that 10 industries purchased 90% of the process control instruments sold in 1972. Production by this group in 1971 was valued at $4.5 billion (see table 3), or more than 25% of the Venezuelan gross national product. Purchases of process control instruments by these industries amounted to $11.3 million in 1972 and should be approaching a level of $29 million in 1978.

Table 1.—Venezuela: Size of market for process control instrumentation, 1970. 1972, 1973

(in thousands of U.S. dollars)

	1970	1972	1973
Electric/electronic instruments			
Production	50	100	300
Imports	2,474	3,606	4,255
Exports	18	11	20
Market size [1]	2,506	3,695	4,535
Nonelectric/nonelectronic instruments			
Production	150	200	500
Imports	2,645	3,596	4,243
Exports	20	5	20
Market size	2,775	3,791	4,723
Automatic control valves			
Production	50	100	150
Imports	6,498	5,091	5,701
Exports	22	70	100
Market size	6,526	5,121	5,751
Total process control instrumentation			
Production	250	400	950
Imports	11,617	12,293	14,199
Exports	60	86	140
Market size	11,807	12,607	15,009

[1] Market size equals production plus imports minus exports.

Source: Bureau of International Commerce, Office of International Marketing research study.

Petrochemical sector.—Chemical processing ranked third largest among the surveyed industries, with production valued at $418.3 million in 1971, when the industry employed 14,493 persons (see table 4). Purchases of process control instruments are projected to exceed $8 million in 1978, as against $2.5 million in 1972.

The petrochemical sector now comprises five companies, only two of which employ 500 or more persons. Production by the sector in 1971 was valued at approximately $4.2 million.

Development of the petrochemical sector has been given high priority by the Venezuelan Government. The National Petrochemical Plan calls for the investment of approximately $2.2 billion over the next 10 years, including several new plants to be developed by the government-owned Venezualan Institute of Petrochemicals (IVP). An additional 13 companies will be formed, utilizing government funds and private capital.

The national plan calls for the development of four complexes. One of them, at El Tablazo, will be the largest single petrochemical complex in the world. Construction was started in 1969 on a 2,000-acre tract located on the eastern side of Lake Maracaibo. IVP is coordinating the operation of this plant with other State institutions, and both national and foreign investors are financing the complex. IVP will operate the gas transformation plant, a chlorine sodium plant, and the industrial support services. Other plants for converting hydrocarbons into petrochemical products will be owned by IVP and private organizations.

Construction of the first stage, which should be completed in 1975, will involve five different companies, some with multiple plants. Annual production will amount to 1.2 million tons of diverse products valued at approximately $140 million. Total investment planned for the first stage is $445 million. Completion of the second stage, costing $500 million, is scheduled for 1976. The entire project is scheduled to be finished by 1980, at which time Venezuela will have about $1.5 billion invested in the petrochemical sector.

Some companies operating plants in the El Tablazo complex include Venezolana de Nitrogeno, which will produce ammonia and urea; Estireno de Zulia, polystyrene; Polimeros del Largo, ammonia; Derivados Vinilicos, raw materials for other plastic and industrial chemical operations; and Elastomeros Internacionales, methanol and polyisoprene.

The complex in Moron, now operated by IVP, is the oldest petrochemical operation in the country. It includes plants for making sodium chloride, fertilizer, and explosives. IVP will invest an estimated $77 million in the complex over the next 3 years to produce ammonia, urea, phosphoric acid, sulfuric acid, and triple superphosphate. It will include funding for a granulation plant. In addition, four companies are planning investments totaling almost $29 million to produce refrigeration gases, sodium phosphate products, aluminum sulfate, and synthetic rubber.

Land preparation has started near Barcelona for Petroquimico de Oriente, a petrochemical complex that will require investments estimated at $930 million. Two plants are scheduled for production of ethylene, four for ammonia, and two for processing liquefied petroleum gas (LPG).

The National Petrochemical Plan includes invest-

Table 2.—Venezuela: Estimated imports of selected process control instruments by country of origin, 1970, 1971, 1972

(in thousands of U.S. dollars)

	1970	1971	1972
Pressure regulating valves and nonelectronic thermostats:			
United States	508	485	727
Germany	65	100	60
Italy	8	44	45
United Kingdom	15	38	11
Others	181	236	276
Total	777	903	1,119
Apparatus for counting, measuring or controlling gases or liquids, revolution counters, level gauges for boilers, accelerometers:			
United States	1,978	2,514	2,725
Germany	242	318	190
Italy	202	207	178
United Kingdom	197	186	69
Others	437	633	1,289
Total	3,056	3,858	4,451
Instruments to determine the physical properties of industrial material:			
United States	419	597	229
Germany	41	62	49
Italy	15	74	25
United Kingdom	—	1	12
Others	128	185	154
Total	603	919	469
Cocks, faucets, valves, and other devices of base metal for regulating the flow of liquids in pipes:			
United States	4,706	4,716	3,199
Germany	151	402	373
Italy	428	279	225
United Kingdom	500	421	56
Others	324	516	678
Total	6,109	6,334	4,531

Source: Estimates based on official Venezuelan trade statistics.

Table 3.—Venezuela: Size of major industries using process control instrumentation
(in millions of U.S. dollars)

Industry	Value of Production 1971	Process control instrumentation consumption 1972	1978
Petroleum [1]	2,148.7	3.2	6.4
Chemical processing	418.3	2.5	8.0
Food processing	1,093.8	1.3	3.2
Primary metals	225.3	1.0	3.8
Utility services	208.4	1.3	3.2
Stone, clay, and glass	223.2	.6	1.6
Paper and paper products	194.2	1.3	1.9
Instruments [2]	3.5	.3	.6

[1] Includes natural gas liquids and pipeline services industries.
[2] Primarily manufacture of professional and scientific instruments.
Source: *Informe Economico 1971*, Banco Central de Venezuela, Caracas; *Estadisticas Industriales, 1971*, Ministerio de Fomento, Caracas; Bureau of International Commerce, Office of International Marketing research study.

ments of $47 million for the Paraguana complex, to be located near the two large refineries run by Creole (Exxon) and Shell in the western part of the country. Naphtha produced by the refineries is to be processed into benzene, toluene, and xylene.

Other projects in the planning stage are a $35-million synthetic fiber complex to produce acrylic and fibers, a $1.9-million plant to produce ethylene and propylene glycols, and a plant to produce proteins from hydrocarbons.

Most of the planned projects in the petrochemical sector are to be joint ventures; the plants will be constructed under turnkey arrangements, with the contractor responsible for design and purchase of new equipment, including instrumentation. The principal contractor is required to purchase through public bids.

Because of the large investments in new facilities, virtually all types of process control instruments will be in demand over the next 5 years. In general, mechanical and pneumatic systems will be in greatest use, although analog electronic systems are gaining greater acceptance. Direct digital control computer systems are likely to be used in a few of the larger projects.

Instruments expected to offer particularly good sales opportunities include:

- Bimetal and glass-column thermometers
- Thermoelectric pyrometers
- Manometers, barometers, strain gages, and piezoelectric devices
- Diaphragms, bellows, and bourdon tubes
- Rotameters, orifices, nozzles, and venturi tubes
- Mass, magnetic, and positive-displacement flowmeters
- Online oxygen analyzers, infrared spectrometers, and automatic titrators
- Online gas chromatographs
- U-tubes and densitometers
- Stroboscopes
- pH meters
- Hygrometers
- Reference and conductivity cells
- Turbidimeters
- Power converters
- Signal converters
- Medium-interface converters
- Transmitters
- Pneumatic analog controllers
- Data loggers, annunciators, and secondary transducers
- Analog recorders
- Analog panel meters
- Liquid level and flow regulator valves
- Solenoid valves
- Switches, dampers, and rheostats

An example of an existing instrument system is found at the new ammonia plant in the Moron complex. The 150-control-loop system, controlling temperature, pressure, and flow, is entirely analog and mainly pneumatic. Taylor provided nearly all of the instrumentation. The new urea plant in the same complex has 40 loops similar to those in the ammonia plant. At Moron's sulfuric acid plant, 12 closed loops plus related panel indicators were recently installed. Honeywell instrumentation is used in the analog systems. The approximate number of control loops currently in use in the Moron installations is 250, including 15 in the sodium chlorine plant and 30 in the thermoelectric plant.

Primary metals industry.—This industry by 1978 is expected to be one of the most important end-users of process control instrumentation, with purchases of $3.8 million. Production in 1971 was valued at $225 million and employment totaled almost 11,000. Ferrous metals is the largest sector in the industry, representing just under 90% of industry production in 1971. Although nonferrous metals production was limited in 1971, the completion of the first stage of a new chrome and tin sheeting plant in 1973 boosted annual production by 150,000 metric tons (MT). Upon completion, this plant is expected to have a capacity of 700,000 MT per year.

The industry comprised 45 firms in 1971. The largest of these is SIDOR, a government-owned enterprise, which produces both ferrous and nonferrous metals. SIDOR has recently completed an expansion program aimed at raising crude iron production to 3 million MT per year.

The Venezuelan Government has programmed rapid growth of the primary metals industry during the next 5 years, with plans to expand operations at the SIDOR mill and to establish several joint ventures for the production and second-stage processing of basic metals.

SIDOR plans to invest $3.5 billion at the Puerto Ordaz complex during the next decade. Two pellet plants are scheduled to be completed in 1977, each

with an annual capacity of 3 million MT of steel. A direct reduction plant should be completed by the end of 1976, and two more are expected to be operational by 1977. Total annual capacity for the production of basic steel is to be expanded by almost 13 million MT between 1975 and 1978. Hot and cold rolling mills are scheduled to be built at the same complex.

In addition, SIDOR plans to spend $43 million in Zulia State for exploration for mineral ores and installation of a wire rolling mill with an annual capacity of 360,000 MT.

Most systems to be installed in new plants will be analog; computer control systems are not expected to be widely used. Strong demand is expected for the following types of process control instruments over the next 5 years:

- Resistance, bimetal, glass-column, and thermopile thermometers
- Thermoelectric and infrared pyrometers
- Manometers, rotameters, and mass- and positive-displacement flowmeters
- Venturi and pitot tubes
- Probes, piezoelectric transducers, and diaphragms
- Barometers
- Densitometers, refractometers, and U-tubes
- Tachometers and stroboscopes
- pH meters and electrodes
- Infrared analyzers and resistance meters
- Reference and conductivity cells
- Online oxygen analyzers and gas chromatographs
- Infrared absorption and mass spectrometers
- Power, signal, and medium-interface converters
- Pneumatic and electronic transmitters
- Analog controllers
- Electric indicating and recovering instruments
- Continuous and scan monitors, data loggers, and secondary transducers
- Globe, 3-way, and butterfly valves
- Positioners
- Self-contained and remote-sensing, direct-actuated temperature regulators
- Solenoid valves
- Switches, rheostats, and dampers

A highly automated, high-iron briquette plant was opened in 1973 by the Orinoco Mining Company, a subsidiary of United States Steel. The plant is the world's first commercial installation of this type. It has approximately 200 loops and contains direct digital control computer systems. Most of the instrumentation was supplied by Honeywell, Taylor, and Foxboro. It reduces iron ore fines from the natural state of 58% iron content to metallic iron with 86.5% iron.

Petroleum and natural gas industry.—This industry is expected in 1978, to be the largest purchaser of process control instrumentation in Venezuela. Sales to producers should double during the 6-year period, rising from $3.2 million in 1972 to $6.4 million in 1978.

Table 4.—Venezuela: Number of establishments and employment by industry, 1971

Industry	No. of establishments	Employees
Food processing	1,441	39,422
Paper and paper products	90	7,107
Chemical processing	291	14,493
Petroleum [1]	22	23,129
Stone, clay, and glass	396	13,443
Primary metals	45	10,669
Utility services	20	45,000
Instruments	13	300

[1] Includes natural gas liquid and pipeline services.
Source: Data based on *Estadisticas Industriales*, Ministerio de Fomento, Caracas.

Petroleum and natural gas processing is the largest industry in Venezuela. Employment totaled 23,000 in 1971, and production reached almost 3.4 million barrels per day (bpd) in 1973. Output declined slightly in 1974. The 22 oil and gas companies have invested $7 billion in the industry. Twenty firms are foreign-owned, and two of them—Creole, a subsidiary of Standard Oil of New Jersey, and Shell—account for 70% of both production and refinery capacity.

Venezuela is the world's third largest exporter of petroleum. Oil represents approximately 50% of all Venezuelan exports, and tax revenue from the petroleum companies accounts for about 70% of total government income.

Trade sources report that the following instrumentation will offer good sales opportunities during the next 4 years:

- Resistance, glass-column, and thermopile thermometers
- Radiation, thermoelectric, and infrared pyrometers
- Barometers, manometers, ionization gages, bellows, bourdon tubes, and diaphragms
- Positive-displacement and mass flowmeters
- Venturi tubes, orifices, and nozzles
- Probes, floats, and pressure gages
- Refractometers and densitometers
- X-ray absorption meters, tachometers, and stroboscopes
- pH meters
- Hygrometers
- Infrared analyzers and resistance meters
- Online oxygen analyzers, spectrometers, and gas and liquid chromatographs
- Converters
- Electric and time-signal telemetric transmitters
- Electric analog controllers
- Continuous monitors, data loggers, and magnetic tape recorders
- Analog indicators
- Electrical analog panel meters
- Globe, 3-way, and butterfly valves
- Remote-sensing, direct-actuated temperature regulators
- Liquid level regulators
- Solenoid valves

The Creole Petroleum Corporation is the largest firm in the industry. Its refinery complex at Amuay has the capacity to process 630,000 bpd of crude oil. Products include fuel oil, gasoline, naphtha, diesel oil, kerosene, asphalt, lubricating oils, and solvent. Fuel oil represents 60% of production.

The newest facilities in the complex are the desulfurization plants. Fuel oil that contains a maximum sulfur content can be produced at a rate of 300,000 bpd. The process controls used in the plants typify the advanced instrumentation used by the petroleum industry. The original electric and analog systems were replaced in 1973 with a complete direct digital control (DDC) system. There are 200 control loops, almost entirely composed of Foxboro instruments. The General Electric process control computers, with both direct digital control and supervisory capacity, regulate the refining processes. The control room has display panels, computer consoles, three printout machines, and six video display units to help monitor the process. The supervisory function is connected with the quality control laboratories so that data and analysis can be fed in online. The computer system required an investment of approximately $3 million.

Sugar and confectionery manufacturing sector.—This is the largest sector in the food processing industry. The value of production by the indusrty was estimated at over $1 billion in 1971, when over 39,000 people were employed in some 1,400 establishments. Market analysts reported that the industry grew by 6% in 1974.

The sugar and confectionery manufacturing sector had 62 firms in 1971, with production valued at $131 million. The 16 sugar mills in the sector produced over 500,000 tons during the 1972-73 season. Five of the mills owned by Corporacion Venezolana de Fomento (CVF), the Venezuelan Development Corporation, accounted for about 15% of total output. The government mills began a major expansion program in 1971 and a year later had $6.9 million invested in equipment and plant facilities.

Long-range government plans call for substantial increases in investments in the sugar processing sector. Expenditures on plant and equipment should total $282 million over a 15-year period, with $164 million of that occurring between 1974 and 1977. Plans include investment of $150 million in three new government mills with a capacity of 6,000 MT per day. The new government mills will be highly automated, utilizing advanced instrumentation. In addition, at least four private mills are under construction or being planned. The control systems will be primarily pneumatic and analog.

The following instruments are likely to be used in the expansion programs:

- Glass-column and resistance thermometers
- Thermoelectric pyrometers
- Manometers, barometers, bourdon tubes, and bellows
- Mass flowmeters
- Floats, pressure gages, and probes
- Tachometers
- pH meters
- Psychrometers and hygrometers
- Resistance meters and infrared analyzers
- Online oxygen analyzers, spectrometers, and gas chromatographs
- Power converters
- Electric-to-pneumatic/pneumatic-to-electric, medium-interface converters
- Pneumatic transmitters
- On/off and proportional pneumatic analog controllers
- Continuous monitors and data loggers
- Mechanical and electromechanical indicators and recorders
- Electrical panel meters

Control loops are now being used in the industry in the following operations: broilers and sugar kettles, machines to concentrate syrup, evaporation processes, cooking of crude syrup, machines for refining of sugar, condenser systems, diffusion systems, and water circulation systems.

Five of the larger plants—El Palmar, Portuguesa, Rio Turbio, C.V.F. Rio Yaracuy, and Yaritagua—have 50 to 75 loops per plant, and production runs between 2,500 and 7,000 MT per day.

Additional Information

This Survey is one of a series based on market research reports prepared overseas for the Office of International Marketing. Current and detailed marketing information on Venezuela to supplement this report is available on a continuing basis from:

Country Marketing Manager—Venezuela
Office of International Marketing
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230
Telephone: 202 967-2995

A loan copy of the original research is available from:

Office of Export Development
BIC/DIBA
U.S. Department of Commerce
Washington, D.C. 20230

Please request: "The Market for Process Control Instrumentation in Venezuela," DIB 74-12-545, April 1974.

The Office of Export Development also has available a "Target Market Trade List: Process Control Instrumentation—Venezuela" for $3.00 which identifies major prospective customers, potential agents and distributors, trade publications, and trade associations.

Duties and Trade Regulations

Under the new customs system established in May 1973, duties are based on the ad valorem value of the shipment. Most specific duties and import licenses were eliminated. Rates generally are in the 1 to 10% range. Venezuela's membership in the Andean Common Market is likely to be the main factor that will affect future imports. Because of uncertainty as to how the Common Market agreements will be applied, prospective suppliers should request current information before making definite plans for market entrance.

Information concerning official duty rates applicable to specific process control instruments may be obtained from the U.S. Department of Commerce, Room 4217, Main Commerce Building, Washington, D.C. 20230.

Technical Requirements

There are no official government standards covering technical or labeling requirements at present, although the Government Regulatory Agency, Normas Venezolanas, is in the process of establishing standards. These are expected to conform to ASA and UL regulations. Products from the United States generally are readily accepted. Gages and other measuring instruments should be in the metric system. Additional information on Venezuela's standards may be obtained from the American National Standards Institute, 1430 Broadway, N.Y., N.Y. 10018.

Country Market Briefs

Abstracts from reports on seven additional country markets for process control instrumentation are contained in this section. The reports were prepared by the commercial sections of the U.S. Embassies and Consulates in the countries surveyed and contain key data on the markets for process control instrumentation.

The original documents are available through the National Technical Information Service, Springfield, Va. 22151.

Argentina

Argentina offers a small but increasingly important market for U.S.-manufactured process control instrumentation. Between 1969 and 1971 imports rose from $8.1 million to $19.3 million, representing an average annual increase of 55%. Although government import restrictions slowed sales in 1972, a favorable trade balance in 1973, coupled with sizable foreign credits, will permit the government to carry out planned expansion projects. As a result, the market should experience rapid—in some cases spectacular—growth beginning in 1975. Planned expansion of major industries offers many sales opportunities to U.S. firms, which have consistently held about 50% of the import market. Foreign manufacturers currently supply almost all of Argentina's process instruments.

Argentine buyers are attracted by the advanced technology and competitive prices of American instruments. Products with particularly good sales records include: Valves, physical and chemical analyzers, and instruments to monitor and control flow, pressure, temperature, and other variables in liquids and gases. Electric and electronic meters, analyzers, and controllers have enjoyed the greatest overall sales. Products certified by the government as noncompetitive with local manufacturers can obtain a license permitting importation at a duty rate of 5% of the value plus insurance and freight.

Government and private organizations are planning to spend $2 billion on 141 projects in the chemical, paper, and metals industries during the 1974-76 period. Argentina is expected to invest $500 million to increase the value of the annual output of petrochemicals to $580 million by 1980. Steel production by 1978 is projected to triple over the 1972 level of approximately 2 million tons, expansion being planned by all 10 major private and semi-private manufacturers and by Somisa, the government-owned corporation. Investments of $380 million will be pumped into the Argentine pulp and paper industry by 1977, and the construction of chemical recuperation plants is expected in the 1980's.

Belgium

The Belgian market for process control instrumentation grew at a steady annual rate of over 17% between 1970 and 1973. Sales totaled almost $163 million in 1973 and are expected to surpass $307 million by 1978. Because local manufacturers have failed to satisfy demand, U.S. and European suppliers have captured almost the entire market. German firms accounted for 49% of 1973 imports. Sales of U.S.-made control instruments dropped from a total value of $17 million in 1970 to $14 million in 1973, due partly to increased production by American subsidiaries in Europe. This trend was expected to reverse after 1974, so that imports from the United States should reach close to $28 million in 1978. American firms can capture a larger share of the market mainly at the expense of European competitors, but in order to do so they must offer rapid delivery and efficient, dependable servicing of equipment.

American goods command great respect with decision makers in the Belgian petroleum refineries and chemical plants. U.S. products now account for 80% of purchases. They also hold a competitive edge in the market for air and water pollution monitors, fine adjustment regulators, and devices for measuring material composition. Other highly regarded U.S. products include process monitors, data loggers and alarms, signal converters, pneumatic and

electric/electronic transmittters, annunciators and automatic control vales.

The petroleum, chemical, and natural gas industries absorbed an estimated 70% of process control instrumentation imports in 1972. In spite of the recent oil shortage, at least two Antwerp refineries, Esso and Albartros, plan major expansions. Over $2 billion will be spent to build and enlarge chemical facilities between 1974 and 1979. The introduction of liquified natural gas into the country from Algeria and the North Sea in 1976 will result in considerable expansion in the industry.

Colombia

Colombia's demand for process control instrumentation is expected to show steady growth through the 1970's. Expansion of petroleum refinery and electricity generating capacity should push the market forward at the same annual rate of increase—8.1%—that it has held since 1971. In 1973, estimates placed the value of the Colombian instrumentation market, which is totally supplied by imports, at approximately $3 million. Sales are expected to increase to $4.4 million by 1978. The U.S. share of the import market dropped from 71% in 1970 to an estimated 58% in 1973; U.S. manufacturers are expected to supply some 55% of imports during the rest of the decade.

Although Colombia presently does not produce process control instruments domestically, the U.S. faces aggressive competition from German, Italian, and Japanese suppliers. American-made goods have traditionally commanded considerable respect among Colombian users and comprised the original instrumentation in most industrial facilities. The most favored items include: Temperature controls, chromatographs, valves, and liquid level and pH meters.

Future expansion of the process control instrument market will come almost entirely from two industries—petroleum and utility services. These industries should account for 38% and 30%, respectively, of process instrument purchases in 1978. The Colombian petroleum industry plans an increase in capacity from 168,000 barrels per day (bpd) in 1973 to 236,000 (bpd) by 1980, requiring investments of $350 to $400 million. Some of the largest projects will be the new Tumaco and Huila refineries and expansion at the Cartagena and Barrancabermeja plants.

Government emphasis on electric power production has resulted in 10 new plants currently under construction and four additional projects to be completed by 1981. This will raise the country's generating capacity by 6 million kilowatts (kW). Larger projects include a $190-million plant on the Patia river, a $214-million hydroelectric plant at Samana, a new $190-million hydroelectric plant in Mesitas, and a planned computerized control center for the large Interconexion Electra S.A. power company, on which bids should be accepted in 1975.

Israel

As the process industries in Israel expand, the market for control instrumentation is expected to grow rapidly. The chemical and food processing industries are expected to increase exports in the future and many major manufacturers will utilize modern process control instrumentation in order to meet world standards for their products. Rising prices of raw materials as well as labor shortages help make such automated devices profitable to Israeli manufacturers.

Approximately 90% of the Israeli market for process control instrumentation is supplied by foreign manufacturers. Imports of process control instrumentation (including some laboratory instruments) totaled $25.5 million in 1972. U.S. manufacturers supply almost half of imports. Israeli buyers prefer American products in spite of their generaly higher price.

The chemicals and petroleum industries are the largest volume purchasers; together they account for 55% of sales of process controls. Israeli's chemical industry is planning to spend between $700 and $900 million during the 1974-81 period on expansion projects. These include increased production of formaldehyde, ethylene, ammonia, and potassium nitrate. About $30 million is expected to be spent for process control instrumentation. The country's main centers of oil refining, Haifa and Ashdod, both plan major additions. Haifa will build two new facilities by 1976. Ashdod will double its capacity by 1979. Israel's food processing industry is aggressively modernizing its existing plants, and purchased instruments valued at nearly $8 million in 1972. Assis Ltd., one of the largest food processors in Israel, plans to invest $10 million in new facilities during the 1974-79 period.

Analog controllers and measurers, on-line gas chromatographs, diaphrams, flowmeters and pressure gauges are expected to show the best sales potential in the near future. Many industrial development plans call for highly sophisticated computer instrumentation.

Korea

Korea offers an expanding but competitive market for manufacturers of process control instrumentation. Purchases of imported equipment comprise almost the entire market, Japan being the largest supplier. U.S. sales increased annually at an average rate of 25% rising from $1.8 million in 1970 to $3.5 million in 1973. Almost all orders for process control instruments are made in connection with major new projects. Foreign partners in these projects generally place orders for instrumentation, and American manufacturers should keep contacts alert for industrial plans in the early development stage. In Korea, the usual stocking-agent plays almost no role in such sales, his function being restricted to supplying replacement parts.

The higher prices and longer shipping time of American orders are counterbalanced by the respect given U.S. technology. Products which have enjoyed the greatest sales include: Pressure valves, and flow, depth, and pressure meters and controllers for gases and liquids.

Demand for process control instrumentation will continue to grow rapidly, due to Korea's Heavy and Chemical Industry Development Plan, designed to dynamically boost production capacity. Output of synthetic fiber—amounting to nearly 70,000 metric tons in 1972—virtually doubled by 1974.

The Korean petrochemical industry is concentrated in the mammoth Ulsan complex. This includes nine plants. Four new plants will be built and four present facilities expanded in the near future. The Chungju and Yongnan Chemical Companies both plan to increase their manufacture of fertilizer, and the Hankok Company to expand its paper and pulp production.

Sweden

U.S. manufacturers of process control instrumentation can expect to find excellent sales opportunities in the expanding Swedish market. Between 1970 and 1973 consumption of process control equipment grew at a steady annual rate of slightly over 10%. Sales estimates totaled almost $53 million in 1973 and are projected to reach $75 million bzy 1978. The market is currently influenced by an investment boom which is generally felt to have peaked. Most industry sources expect the current high rate of growth to decline slightly in some areas through 1976, after which a new cycle of investment is expected to create higher levels of demand.

Because local manufacturers have been unable to satisfy demand, over 90% of the total market is supplied by imports. Direct imports from the United States, accounting for approximately 18% of total sales, were valued at $9.4 million in 1973 and are expected to reach $14.5 million in 1978; this would represent a 9% average annual growth rate. Other leading suppliers include Great Britain and West Germany.

Low tariffs and the good reputation of U.S. instruments will continue to assure opportunities for U.S. suppliers. The best sales prospects exist in the field of automatic or high technology instruments, valves, and integrated systems. Process computers, supervisory control systems, on-stream analyzers, and automatic control valves are all enjoying increased demand. Innovative technology and new instrument designs can also help increase the market share of U.S. goods.

The pulp and paper industry and petroleum refineries are the prime consumers of process control instrumentation. Total production of paper and paperboard in 1972 amounted to 5.2 million metric tons (sales were approximately $950 million). The present level of capital investment in the paper production sector is estimated at about $200 million annually and has been increasing at the rate of 10% a year. Historically, expansion in the paper industry runs in 5-year cycles. By this guidemark, a sizable increase in investment may be expected around 1977 or 1978.

Sweden has four petroleum refineries with a fifth being planned. In spite of the oil shortages, three of the four refineries are planning major expansions. If these plans fully materialize, Swedish refinery capacity will triple. Present and planned refineries are considered to be at the same technological level as similar installations in the United States. Electronics instrumentation probably has a slight edge over pneumatic types of equipment.

Switzerland

Switzerland continues to offer a large, expanding market to U.S. suppliers of process control instrumentation. Conservative estimates place the total value of 1973 sales at $280 million. Sales in 1978 are expected to reach $493 million, representing an average annual increase of 12%. Swiss manufacturers are able to meet only 20 to 30% of local demand, the remainder is supplied by imports. Foreign manufacturers in the market include West Germany, the leading supplier, followed by the United States, Great Britain, and Holland.

Imports from the United States, estimated at $34.4 million in 1973, are expected to reach $56.4 million by 1978—a 10% yearly increase.

American process control instruments are well known in the Swiss market and have always enjoyed an excellent reputation for sophistication and quality. Recent currency realignments, liberal Swiss trade policies, and small import duties should continue to assure a favorable competitive environment for U.S.-supplied equipment. In some fields, notably those of signal converters, pressure regulators, safety valves, and thermostats for specific purposes, U.S. manufacturers hold a major share of the market by virtue of their technological lead.

Regulations and control systems, especially of the electronic and electro-pneumatic type, will offer the most dynamic growth in the 1973-78 period. Other instruments with high sales potential are transmitters, signal and medium-to-interface converters, valves, controllers, and monitors. The only obstacles which U.S. suppliers face are safety and performance standards imposed by the Swiss Electrotechnical Society. However, these do not constitute a serious barrier to the foreign manufacturer committed to expanding its position in the Swiss market.

An acute labor shortage for nearly a decade has encouraged Swiss companies to automate manufacturing processes to the fullest extent possible. Only through the application of the most modern process technology may Swiss manufacturers hope to expand their production significantly. The chemical, engineering, and food processing industries, principal manufacturing sectors of the Swiss economy, are the chief end-users of process control instrumentation. The chemical and engineering industries alone account for over 60% of total process control equipment consumption.

The chemical industry in 1972 had $5.2 billion in sales, while at the same time investing $420 million in plant modernization and equipment and another $400 million in research and development. Swiss companies will be concerned primarily with replacing obsolete equipment with modern, largely automated machinery and instruments. A case in point is the current reconstruction of a dyestuffs factory by a component of the Basel Chemical Companies. Mechanical instruments are being replaced by a combination of electronic and pneumatic process control instruments. The Swiss government, committed to cleaning up lakes and rivers and dealing with critical waste problems, is spending $1 billion between 1970 and 1980 on pollution control. The government is expected to increase its purchases of process control instruments.

U.S. Government Services Available To American Exporters

MARKETING ASSISTANCE AND INFORMATION

Foreign Promotional Events

The Department of Commerce sponsors a variety of active promotional events designed to assist American firms and their representatives in developing export markets. Organized and staged by the Office of International Marketing (OIM), the events listed below are utilized by U.S. exporters to penetrate new markets, increase sales, and find foreign agents and distributors for their products.

- Commerce-sponsored Trade Shows
- "Between Show Promotions"
- Specialized U.S. Trade Missions
- Joint Export Establishment Promotions (JEEP)
- Technical Sales Seminars
- Catalog Exhibitions

A description of the above and a schedule of 1975 and 1976 events suitable for promoting exports of process control instrumentation may be found on page 000. Non-U.S. sponsored events also are listed.

U.S. Trade Promotion Facilities Abroad

U.S. trade promotion facilities abroad provide U.S. manufacturers with a unique method of testing and selling in key foreign markets through commercial show rooms established in central marketing areas where the potential for American products is continuous. The Trade Development Office in Warsaw, however, does not have exhibit facilities.

Information on exhibitions at U.S. trade promotion facilities abroad may be obtained from the Country Marketing Managers or the Commerce district offices listed on the following pages.

Listed below the the 17 U.S. trade promotion facilities located in major cities in Europe, Asia, Australia and Latin America.

AUSTRALIA—U.S. Trade Center
37 Pitt Street
Sydney NSW 2000

AUSTRIA—U.S. East West Trade Center
Prinz Eugen Strasse 8-10
A-1040
Vienna

FRANCE—U.S. Trade Center
123 Avenue Charles de Gaulle
92200 Neuilly
Paris

GERMANY—U.S. Trade Center
Bockenheimer Landstrasse 2-4
D-6000 Frankfurt/Main

IRAN—U.S. Trade Center
Queen Elizabeth II Boulevard
and Kh. Attarzadeh
Tehran

ITALY—U.S. Trade Center
Via Gattamelata 5
20149 Milan

JAPAN—U.S. Trade Center
Tameike Tokyu Building
1-14 Akasaka, 1-Chome
Minato-Ku
Tokyo 107

—American Merchandise Display Center
Sankei Kaikan Building
27, Umeda-Cho, Kita-Ku
Osaka

KOREA—U.S. Trade Center
American Embassy
82 Sejon-Ro
Seoul

LEBANON—U.S. Trade Center
American Embassy
Ali Reza Building
Corniche at Avenue de Paris
Beirut

MEXICO—U.S. Trade Center
Liverpool No. 31
Mexico 6, D.F.

POLAND—U.S. Trade Development and Technical Information Office
Ulica Wiejska 20
Warsaw

SINGAPORE—U.S. Trade Center
268 Orchard Road
Yen San Building
Singapore 9

SWEDEN—U.S. Trade Center
Vasagatan 11
Stockholm

TAIWAN—U.S. Trade Center
Nanking East Road
Taiwan Glass Co. Bldg.
Taipei

UNITED KINGDOM—U.S. Trade Center
4/5 Langham Place
London W1

U.S.S.R.—U.S. Commercial Office in Moscow
c/o American Embassy
Department of State
Washington, D.C. 20520

Country Consultants

Country Marketing Managers (CMMs) are prepared to provide U.S. firms with marketing information by specific country: Market facts, counseling on the preparation of effective marketing plans, selection of best opportunity markets, and assistance in participating in Commerce trade promotion activities. The CMM also can assist in obtaining other foreign business information available within the U.S. Government.

Popular among American businessmen seeking up-to-date marketing information are these publications available through Country Marketing Managers:

- *Overseas Business Reports,* covering marketing and "doing business" information, economic data, and trade statistics in specific countries. Approximately 75 reports are issued annually.
- Articles in *Commerce Today,* the Commerce biweekly magazine, on economic trends, trade developments, and Commerce-sponsored trade events; special reports on timely developments and opportunities.
- *Global Market Surveys* condense the findings of field research conducted in 20-25 of the best country markets. See Preface for a listing of available titles and the section, Global Marketing Program, for themes scheduled for attention during 1975-77.
- *Country Market Surveys* presenting information based on market research conducted abroad with the cooperation of the U.S. Foreign Service. Generally concerning narrowly-defined product categories, these reports provide marketing information useful to the export sales decision-makers of American industry.
- Comprehensive Country Surveys illuminate the factors creating sales oportunities in market sectors in subject countries. They discuss growth by industry sector and the demand for U.S. capital goods over the next 5 years. The first comprehensive report, *Brazil: Survey of U.S. Export Opportunities,* is now available, while reports on Nigeria and Venezuela are in preparation and scheduled for release in late 1975.
- Special reports are prepared on timely opportunities and developments. Typical of these are: *Impact of Currency Realignment on U.S. Exports to Germany* (1973), *The Market for Selected U.S. Capital Goods in Ecuador and Peru,* (1975), *The Australian Market for U.S. Consumer Goods* (in preparation), and a special report on the market for U.S. consumer goods abroad.

In addition, Country Marketing Managers receive an enormous quantity of information, on their countries both published and unpublished. This data comes from private and public sources, American and foreign. It includes periodic reports received from the commercial sections of U.S. Embassies providing accurate information on selected industries or product categories, "best prospects" for the coming year, and new developments and opportunities of special interest to the U.S. business community.

The Country Marketing Manager provides guidance and direction in commercial activities to the U.S. Foreign Service of the Department of State, Trade Center Staffs, commercial fairs staffs, and other trade promotion personnel. This includes the planning and implementation of trade promotional activities listed earlier ("Foreign Promotional Events") within his respective country or countries. The CMM is the focal point in Commerce for the development and implementation of the annual Country Commercial Program, jointly prepared by Commerce and the Foreign Service. This operational planning document establishes objectives and priorities for U.S. Government trade promotion and support of U.S. business by country and the actions to be undertaken to achieve them.

For further information and assistance on marketing in any of these countries, please call or write the appropriate manager. These key contacts may be reached by writing to:

Country Marketing Manager—(specify area)
U.S. Department of Commerce
Washington, D.C. 20230

or by dialing (202) 967—plus the listed extension:

BUREAU OF INTERNATIONAL COMMERCE

Office of International Marketing

Area	Extension
Africa	
Central Africa	3904
East and Southern Africa	4927
West Africa	

Europe and Canada

Canada and Benelux Countries	3848
France	4504
Austria and West Germany	4414
Italy and Greece	3944
Nordic Countries	4601
Spain and Portugal	3957
Switzerland, Yugoslavia and Turkey	2795
United Kingdom	3713

Far East

Australia and New Zealand	3646
East Asia	5401
Japan	2427
South Asia	3137
South East Asia	3875

Latin America

Brazil	5427
Andean and Caribbean Countries	4463
Mexico, Central America and Panama	5020
Argentina, Paraguay and Uruguay	2428

Commerce Action Group for the Near East

Africa, Northern	5737
Bahrain Iraq, Jordan, Kuwait, Lebanon, Oman, People's Democratic Republic of Yemen, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen Arab Republic	5767
Egypt, Iran and Israel	3752

BUREAU OF EAST-WEST TRADE

Office of East-West Trade Development

Eastern Europe	2645
USSR	4655
Peoples' Republic of China	2420

Export Information Services

The export information services described below can be obtained by contacting the U.S. Department of Commerce, Office of Export Development, Export Information Division, Room 1033, Washington, D.C. 20230, or the nearest of the Department's 43 district offices (listed following this section). Recently modernized data handling and retrieval techniques now make many services available in a fraction of the time previously necessary.

Trade Lists

Names and addresses of foreign distributors, agents, purchasers, and other firms are made available to U.S. firms through a series of trade lists. *Target Market Trade Lists are* published by country on each Global Market Survey theme (see Preface). *Business Firms Trade Lists* cover all commercial establishments in smaller developing countries. *State Trading Organizations Trade Lists* name and describe government-controlled foreign trade organizations in nonmarket economy countries.

World Traders Data Reports

World Traders Data Reports (WTDR's) provide descriptive background information on specific foreign firms. Prepared by the U.S. Foreign Service, the WTDR's include such information as year of establishment, method of operation, lines handled, size of sales territory, name of chief executive, general reputation in trade and financial circles, names and addresses of credit sources, names of the firm's connections, and other commercial information. The complete name, street and city address of the foreign firm must be given when requesting this service. Nominal fee.

Agent/Distributor Service

The Agent/Distributor Service helps U.S. firms find agents or distributors for their products in almost every country of the world. U.S. Commercial Officers overseas will identify up to three foreign firms that have expressed interest in a specific U.S. proposal. The charge for this service is $25.

Application forms (DIB—424P) may be obtained from any Commerce Department District Office.

Export Mailing List Service

The Export Mailing List Service (EMLS) provides lists of foreign firms considered prospective customers for U.S. firms. Firms are received from the automated Foreign Traders Index. Their names and addresses are available on gummed mailing labels or in standard printout form. Printouts also include: Name and title of an officer, type of organization, year of establishment, relative size, number of employees and salespersons, and product and/or service codes (Standard Industrial Classification numbers).

A nominal 'Set-up" charge also covers the first 300 entires retrieved. Beyond 300, a small additional cost per name is charged. Delivery can be made in about 15 days.

Foreign Traders Index (FTI) Data Tape Service

This service is offered as a convenience to firms that have a continuing need for a broad range of foreign commercial data, such as export management firms selling a wide range of products. This service provides, in magnetic tape form, information on all firms in one or more countries covered in the Foreign Traders Index. Users may thus retrieve various segments of FTI data by running tapes through their own computer facilities. There is a flat fee for this service on a per-country basis for up to 15

countries. A single, fixed charge is made for a package of 15 or more countries or for the entire file.

Overseas Business Opportunities

The overseas business opportunities services described below can be obtained by contacting the U.S. Department of Commerce, Office of Export Development, Overseas Business Opportunities Division, Room 2323, Washington, D.C. or the nearest of the Department's 43 district offices.

Trade Opportunities Program

The Trade Opportunities Program (TOP) receives up-to-date trade leads from over 200 Foreign Service posts around the world daily and disseminates them to U.S. suppliers. Trade opportunities are based on inquiries by overseas companies who wish to purchase American products or services, or who are interested in representing U.S. firms. Trade opportunities may come from private commercial organizations, from foreign governments, or even from multinational organizations such as NATO or the UN.

To register for TOP, U.S. firms are requested to specify their product and country interests and the types of commercial information desired—direct sales, representation, and/or foreign government tenders. As leads are developed by the Foreign Service, they are cabled to Washington, where they are matched by computer against the criteria established by U.S. companies. These leads are then mailed to appropriate U.S. firms within a week of their origination overseas. Trade leads are charged against prepaid subscriptions.

Overseas Product Sales Group

The Overseas Product Sales Group (OPS) provides personalized assistance to TOP subscribers, or to firms identified as having high export capability, in bidding against foreign competitors for specific export sales opportunities with a value of $1 million or more. The OPS specialists collect, inventory and disseminate early information on export sales opportunities from TOP and a variety of other sources.

Foreign Investment Services Staff

The Foreign Investment Services Staff (FISS) is the focal point for American and foreign business inquiries relating to U.S. investment and licensing abroad. American businessmen are assisted in locating potential overseas licensees and partners, are provided with investment data on specific regions and countries, and then guided toward sources of capital for these proposed projects. Foreign investment and licensing proposals for which U.S. participation and technology is sought are published regularly in *Commerce Today* and are brought to the direct attention of American firms where appropriate. In carrying out its broad range of activities, FISS works closely with other U.S. Government assistance sources, multinational agencies and private regional investment organizations.

Offiice of Export Administration

Information on U.S. export controls may be obtained from the U.S. Department of Commerce, Bureau of East-West Trade, Office of Export Administration, Washington, D.C. 20230. Telephone: (202) 967-4811.

Commerce District Offices

The 43 U.S. Department of Commerce district offices listed below represent the Department in their respective localities and assist in carrying out the programs of the Department. Under the direction of the Office of Field Operations, these district offices are staffed by experienced specialists prepared to help in the solution of business problems and to assist in exporting.

ALBUQUERQUE, NEW MEXICO 87101
U.S. Courthouse—Room 316
Area Code 505 Tel. 766-2386

ANCHORAGE, ALASKA 99501
412 Hill Building
Suite 412
632 Sixth Avenue
Area Code 907 Tel. 265-4597/8

ATLANTA, GEORGIA 30309
Suite 523, 1401 Peachtree St., N.E.
Area Code 404 Tel. 526-6000

BALTIMORE, MARYLAND 21202
415 U.S. Customhouse
Gay and Lombard Streets
Area Code 301 Tel. 962-3560

BIRMINGHAM, ALABAMA 35205
Suite 200-201
908 South 20th Street
Area Code 206 Tel. 325-3327

BOSTON, MASSACHUSETTS 02116
10th Floor, 441 Stuart Street
Area Code 617 Tel. 223-2312

BUFFALO, NEW YORK 14202
910 Federal Building
111 West Huron Street
Area Code 716 Tel. 842-3208

CHARLESTON, WEST VIRGINIA 25301
3000 New Federal Office Building
500 Quarrier Street
Area Code 304 Tel. 343-6181, Ext. 375

CHEYENNE, WYOMING 82001
6022 O'Mahoney Federal Center
2120 Capitol Avenue
Area Code 307 Tel. 778-2151

CHICAGO, ILLINOIS 60603
Room 1406
Mid-Continental Plaza Bldg.
55 E. Monroe Street
Area Code 312 Tel. 353-4450

CINCINNATI, OHIO 45202
8028 Federal Office Building
550 Main Street
Area Code 513 Tel. 684-2944

CLEVELAND, OHIO 44114
Room 500, 666 Euclid Avenue
Area Code 216 Tel. 522-4750

COLUMBIA, SOUTH CAROLINA 29204
Forest Center
2611 Forest Drive
Area Code 803 Tel. 765-5345

DALLAS, TEXAS 75202
Room 3E7, 1100 Commerce Street
Area Code 214 Tel. 749-1515

DENVER, COLORADO 80202
Room 161, New Customhouse
19th and Stout Streets
Area Code 303 Tel. 837-3246

DES MOINES, IOWA 50309
609 Federal Building
210 Walnut Street
Area Code 515 Tel. 284-4222

DETROIT, MICHIGAN 48226
445 Federal Building
Area Code 313 Tel. 226-3650

GREENSBORO, NORTH CAROLINA 27402
203 Federal Building
West Market Street, P.O. Box 1950
Area Code 919 Tel. 275-9111, Ext. 345

HARTFORD, CONNECTICUT 06103
Room 610-B, Federal Office Building
450 Main Street
Area Code 203 Tel. 244-3530

HONOLULU, HAWAII 96813
286 Alexander Young Building
1015 Bishop Street
Area Code 808 Tel. 546-8694

HOUSTON, TEXAS 77002
1017 Federal Office Building
201 Fannin
Area Code 13 Tel. 226-4231

INDIANAPOLIS, INDIANA 46204
Room 355, Federal Office Building
46 East Ohio Street
Area Code 317 Tel. 269-6214

KANSAS CITY, MISSOURI 64106
Room 1840, 601 East 12th Street
Area Code 816 Tel. 374-3142

LOS ANGELES, CALIFORNIA 90024
11201 Federal Building
11000 Wilshire Blvd.
Area Code 213 Tel. 824-7591

MEMPHIS, TENNESSEE 38103
Room 710, 147 Jefferson Avenue
Area Code 901, Tel. 534-3213

MIAMI, FLORIDA 33130
Room 821, City National Bank Building
Area Code 305 Tel. 350-5267

MILWAUKEE, WISCONSIN 53203
Straus Building
238 West Wisconsin Avenue
Area Code 414 Tel. 224-3473

MINNEAPOLIS, MINNESOTA 55401
306 Federal Buildnig
110 South Fourth Street
Area Code 612 Tel. 725-2133

NEWARK, NEW JERSEY 07102
Gateway Building (4th Floor)
Area Code 201 Tel. 645-6214

NEW ORLEANS, LOUISIANA 70230
Chromalloy Building
120 South Central Avenue
Area Code 314 Tel. 622-4243

NEW YORK, NEW YORK 10007
41st Floor, Federal Office Building
26 Federal Plaza, Foley Square
Area Code 212 Tel. 264-0634

PHILADELPHIA, PENNSYLVANIA 19106
10112 Federal Building
600 Arch Street
Area Code 215 Tel. 597-2850

PHOENIX, ARIZONA 85004
508 Greater Arizona Savings Bldg.
112 North Central Ave.
Area Code 602 Tel. 261-3285

PITTSBURGH, PENNSYLVANIA 15222
431 Federal Building
1000 Liberty Avenue
Area Code 412 Tel. 644-2850

PORTLAND, OREGON 97205
Suite 501, Pittock Block
921 S.W. Washington Street
Area Code 503 Tel. 221-3001

RENO, NEVADA 89502
2028 Federal Building
300 Booth Street
Area Code 702 Tel. 784-5203

RICHMOND, VIRGINIA 23240
8010 Federal Building
400 North 8th Street
Area Code 804 Tel. 782-2246

ST. LOUIS, MISSOURI 63103
International Trade Mart, Room 432
2 Canal Street
Area Code 504 Tel. 589-6546

SALT LAKE CITY, UTAH 84138
1203 Federal Building
125 South State Street
Area Code 801 Tel. 524-5116

SAN FRANCISCO, CALIFORNIA 94102
Federal Building, Box 36013
450 Golden Gate Avenue
Area Code 415 Tel. 556-5860

SAN JUAN, PUERTO RICO 00902
Room 100, Post Office Building
Area Code 809 Tel. 723-4640

SAVANNAH, GEORGIA 31402
235 U.S. Courthouse & Post Office Building
125-29 Bull Street
Area Code 912 Tel. 232-4321, Ext. 204

SEATTLE, WASHINGTON 98109
Room 706, Lake Union Building
Area Code 206 Tel. 442-5615

FINANCING EXPORT SALES

The Export-Import Bank of the United States (Eximbank) is an independent agency of the U.S. Government which works directly with American suppliers and private financial institutions to finance U.S. export sales. Eximbank has numerous financing programs to assist U.S. firms. These include direct loans, bank guarantees, discount loans to commercial banks, leasing guarantees, and other programs to cover overseas design and engineering studies.

Financing packages for major industrial projects and exports of high value products are normally supported under Participation Financing, a combination of the Direct Loan and Financial Guarantee programs.

Direct Loans are dollar credits extended by Eximbank to borrowers outside the United States for purchases of U.S. goods and services. Disbursements under the loan agreement are made in the United States to the suppliers of the goods and services, and the loans, plus interest, are repaid in dollars by the borrowers.

Eximbank will extend its Financial Guarantee to cover loans made by U.S. financial institutions to foreign government or private purchasers of U.S. goods and services. The Financial Guarantee will unconditionally guarantee repayment by a borrower of up to 100% of the outstanding principal due on such loans plus interest equal to the U.S. Treasury rate for similar maturities, plus 1% per annum on the outstanding balances of the loan. Comparable guarantees are available to non-U.S. financial institutions under somewhat diffeernt terms.

Of particular importance to U.S. businessmen is Eximbank's Cooperative Financing Facility program which supports medium-term financing in all major markets. Eligible overseas banks are extended a line of credit for half of the funds needed for each transaction, presently at 8% interest, and the cooperating banks provide the other half at local market rates. These banks make credit judgments regarding the customer and can consummate transactions with a minimum of difficulty. Eximbank currently has established approximately 300 such working arrangements with foreign financial institutions (private and public) in over 100 countries.

Eximbank's Commercial Bank Exporter Guarantee program, another activity of special interest to exporters, provides guarantees covering the credit and political risks of non-payment of medium-term (181 days to 5 years) export debt obligations purchased by U.S. banking institutions on a non-recourse basis from the exporters. The fee charged for Eximbank's guarantee depends upon (1) the classification accorded the country of import, (2) the length of the repayment terms, and (3) the financial condition of the overseas buyer.

As a general rule, all transactions supported by Eximbank must include a minimum 10% cash payment by the buyer and must have reasonable assurance of repayment.

The Bank is directed by statute to supplement and encourage private capital, not compete with it. Selected product lines and services to designated markets are excluded from the agency's support; however, the overwhelming majority of U.S. export products and markets are covered. Details on the exceptions are available from U.S. commercial banks or directly from Eximbank.

Businessmen are specifically invited to utilize Eximbank's counseling services for exporters, banks and financial institutions seeking financing for U.S. exports. The services include information on the availability of financing within the United States and abroad, as well as on each of the pertinent Eximbank programs.

For additional information, contact the Export-Import Bank of the United States, 811 Vermont Avenue, N.W., Washington, D.C., 20571, or Telex 89-461.

EXPORT CREDIT INSURANCE

The Foreign Credit Insurance Association (FCIA) is an association of 53 stock and mutual insurance companies in partnership with the Export-Import Bank of the United States. It offers a comprehensive selection of credit insurance policies which protect policy holders against loss from failure to receive payment from foreign buyers.

The benefits of this coverage may be summed up as follows:

- It protects the exporter against the failure of the buyer to pay his dollar obligation for commercial or political reasons.
- It enables the exporter to offer foreign buyers competitive terms of payment.
- It supports the exporter's prudent penetration of higher risk foreign markets.
- It gives the exporter greater financial liquidity and flexibility in administering his foreign receivables portfolio.

Who May Be Insured

Virtually any corporation, partnership or individual doing business in the United States is eligible for FCIA coverage. An exporter may apply for a policy for himself or may become insured under the blanket policy of a bank or other financial institution which holds an FCIA policy.

Eligible Products

Foreign sales of all types of industrial, agricultural, and commercial products produced in the United States and of services rendered by U.S.-based personnel are eligible for FCIA insurance.

What Losses Are Covered

Comprehensive FCIA policies protect insureds against non-payment of receivables due to unforeseeable commercial and political occurrences. Commercial risks which are covered include insolvency of the buyer or protracted defaults which may well arise from economic deterioration in the buyer's market area, shifts in demands, unanticipated competition, tariffs, or technological changes. Also covered are defaults due to such buyer problems as increasing expenses, the loss of key personnel, and natural disasters.

Political risks coverage applies to defaults due to governmental action and to political disturbances such as war, revolution, and insurrection. Such events may result in confiscation of the buyer's assets, detention or diversion of shipments, or cancellation of necessary licenses by the United States or by the buyer's country. Also covered is the inability or refusal of the foreign central bank involved to convert the buyer's currency to dollars. Political coverage alone is available for exporters who desire to assume their own commercial risks.

The Policies

The policies offered by FCIA are many and varied. They can be tailored to suit the needs of the individual exporters, service groups, and financial institutions. Aside from a small applicant fee, all premiums are paid only for goods actually shipped.

The Master Policy combines a deductible provision, discretionary credit authority, and once-a-year reporting to provide qualified exporters with lower premiums, independent credit decisions, faster services to overseas buyers, and less paperwork. It is a blanket policy which requires the exporter to insure all or a reasonable spread of his exportation.

The Short-Term Policy is a blanket poicy which covers sales on terms of up to 180 days. It provides coverage of 90% for commercial losses and 95% for political losses. A moderate discretionary credit limit is included for each buyer.

The Medium-Term Policy provides 90% coverage (political and commercial) for capital and quasi-capital goods sold on terms of 181 days to 5 years. The policy is written on a case-by-case basis so an exporter need not insure all his medium-term transactions as he would under a blanket policy.

The Combination Policy provides short- and medium-term insurance to protect U.S. exporters in transactions with overseas dealers and distributors. It includes flexible coverage for short-term sales and for both inventory and receivable financing.

The Comprehensive Services Policy insures the receivables generated by the performance of services for foreign customers by U.S.-based personnel, or by U.S. personnel temporarily assigned overseas. Industries benefiting from this coverage include management consultants, engineering and related construction consulting services, and transportation companies.

Special Coverage Endorsements are available in addition to the above policies. These include endorsements to cover specified preshipment risks and consignment selling.

An Aid to Financing

FCIA does not finance export sales. However, the exporter who insures his accounts receivable against commercial and political risks is usually able to obtain financing from commercial banks and other

lending institutions at lower rates and on more liberal terms than would otherwise be possible.

Prequalification of Buyers

FCIA's rapidly expanding prequalifying (P.Q.) program is now providing credit information on overseas buyers through its computerization data system. All the exporter needs to do is telephone the nearest FCIA office to determine whether a particular buyer is prequalified for the amount of his purchase.

Information about FCIA

More information about FCIA's services, and applications for policies, may be obtained through insurance agents or brokers or through FCIA's network of full-service regional offices. General questions and specific inquiries may be directed toward the FCIA Ombudsman in the New York office. Call (213) 432-6216 for a direct connection.

FCIA Offices

One World Trade Center—9th Floor
New York, New York 10048
Phone: (212) 432-6200

Suite 1003—William-Oliver Bldg.
32 Peachtree Street, N.W.
Atlanta, Georgia 30303

Suite 1552
10 South Riverside Plaza
Chicago, Illinois 60606

Suite 1315
55 Public Square
Cleveland, Ohio 44113

Suite 1790
611 West Sixth Street
Los Angeles, California 90017

Suite 1110—First Federal Bldg.
700 North Water Street
Milwaukee, Wisconsin 53202

C & I Bldg.—Suite 1408
1006 Main Street
Houston, Texas 77002

Suite 205
1 Embarcadero Center
San Francisco, California 94111

Woodward Bldg., Suite 420
15th & H Streets, N.W.
Washington, D.C. 20005

Schedule of Trade Promotional Events

PROCESS CONTROL INSTRUMENTATION

The schedule of promotional events for 1975 and 1976 lists appropriate activities for promoting sales of process control instrumentation to overseas customers.

The Schedule provides a chronological listing, by country, covering the following types of promotional activities:

- **International Trade Fairs**—Privately sponsored, foreign managed international exhibitions in which U.S. firms may exhibit their products on an individual basis.
- **Conferences, Congresses, Seminars and Symposia**—Privately sponsored, international activities in which U.S. firms may participate on an individual basis. Some of these events are held in conjunction with international trade fairs; others are held independently.
- **Trade Center Exhibits**—Well-defined product groups with prime market prospects and identified end-users are drawn together at U.S. trade promotion facilities abroad backed up by intensive promotion campaigns to attract the right buying audience.

Information for all the listed events is, of course, subject to change, and should be verified with sponsors or contacts for those in which you are interested. Some of the earlier events may be closed to additional participants by the time this Survey is published; information on these will, however, be helpful to those wishing to attend or to arrange for participation in future occurrences of events held periodically.

Events sponsored by or participated in by the U.S. Department of Commerce appear in boldface letters on the Schedule.

Additional Commerce-sponsored promotional activities may be scheduled from time to time. These include:

- **"Between Show Promotions"**—During periods between major shows, individual U.S. firms, or their authorized representatives, are encouraged to use the U.S. trade promotion facilities abroad (see list on p. 107) stage one-company product promotions or sales seminars.
- **Joint Export Establishment Promotions (JEEPs)**—Tailor-made promotions designed to help small groups of U.S. manufacturers of related products to inexpensively penetrate new markets on a shared-cost basis.
- **Technical Sales Seminars**—These events, aimed at high technology markets, combine practical panel discussions by U.S. technology experts with individual private appointments. Additionally, these teams of U.S. industrial representatives on multi-country itineraries receive U.S. Embassy briefings, tour local installations and conduct sales interviews, according to each represented company's marketing objectives.
- **Catalog Exhibitions**—Special displays of company catalogs, usually of a single industry, to test markets, develop sales leads, and locate agents and distributors.
- **Specialized U.S. Trade Missions**—U.S. Department of Commerce organizes and sponsors Trade Missions covering selected product themes based on available market research and Foreign Service recommendations. Commerce establishes the overseas itinerary, pays the mission's operating expenses, and provides an Advance Officer and Mission Director.

For further information regarding events sponsored by or participated in by the U.S. Department of Commerce, contact any one of the 43 Commerce district offices, or the Country Marketing Manager. Additional information on all other events may be obtained from the contact indicated in the Schedule of Events for the particular activity.

Schedule of Trade Promotional Events 1975-1976

EVENTS	1975	1976
ARGENTINA		
INSTRUMENTATION, ACCESSORIES, AND PROCESS CONTROL SYSTEMS EXHIBITION Location: Buenos Aires Sopnsor: Sociedad Argentina de Control Automatico Maipu 645—3° Piso—Buenos Aires, Argentina Frequency: Annual	Date Not Set	Date Not Set
FIFTH NATIONAL SYMPOSIUM OF AUTOMATIC CONTROLS (with exhibit) Location: Buenos Aires Sponsor: Sociedad Argentina de Control Automatico Maipu 645—3° Piso—Buenos Aires, Argentina Frequency: Annual	Date Not Set	Date Not Set
AUSTRALIA		
LABTRONICS Location: University of N.S.W., Sydney Sponsor: Conventions and Exhibitions Administration P.O.B. 259, Roseville, NSW, 2069, Australia Frequency: Annual	May 27-30	Spring
ENVIRONMENT '75 Location: R.A.S. Showgrounds, Sydney Sponsor: Total Concept Exhibition Pty. Ltd. 57 Ethel St., Balgowlah, NSW, 2093 Frequency: Annual	July 2-6	Summer
AUSTRALIAN INTERNATIONAL ENGINEERING EXHIBITION (AIEE), INTERNATIONAL GAS, CHEMICAL, PETROLEUM EXHIBITION (IGCPE), and INSTRUMENTS, AUTOMATION AND ELECTRONIC CONTROL EXHIBITION (IAECE) Location: Exhibition Building, Melbourne Sponsor: Thomson Exhibition Promotions Pty. Ltd. 47 Chippen St. Chippendale, NSW, 2008 Australia Frequency: Annual	July 28 Aug. 2	Summer
INTERNATIONAL CONTROL ELECTRONICS TELECOMMUNICATIONS INSTRUMENTS AUTOMATION EXHIBITION Location: Exhibition Building, Melbourne Sponsor: Conventions and Exhibitions Administration P.O. Box 259, Roseville, NSW, 2069, Australia Frequency: Annual	Oct.	Fall

EVENTS	1975	1976
AUSTRALIA—Continued		
INTERNATIONAL POWER CONTROL AND INSTRUMENTATION EXHIBITION AND CONFERENCE Location: R.A.S. Showgrounds, Sydney Sponsor: Convention and Exhibition Administration P.O. 259, Roseville, NSW Frequency: Annual	Oct. 20-25	
FRANCE		
MESUCORA (INTERNATIONAL EXHIBITION OF AUTOMATION, CONTROL AND MEASURING INSTRUMENTS) Location: ENIT, Palais de la Defense, Sponsor: Association Mesucora, 23, rue de Luebeck, 75116, Paris Frequency: Triennial		April
INTERCLIMA (INTERNATIONAL EXHIBITION OF HEATING, REFRIGERATION AND AIR CONDITIONING TECHNIQUES) Location: Porte de Versailles, Paris Sponsor: 7 rue Copernic, 75782 Paris, France Frequency: Biennial		June
MATERIAL (INTERNATIONAL FOOD INDUSTRIES EQUIPMENT EXHIBITION) Location: Porte de Versailles, Paris Sponsor: 42, rue du Louvre, 75001 Paris, France Frequency: Every four years		November
GERMANY		
HANNOVER FAIR (ELECTRICAL EQUIPMENT SECTOR) Location: Messegelaende, Hannover, Germany Sponsor: Deutsche Messe und Ausstallungs GmbH 3 Hannover, Germany Frequency: Annual	April 16-24	Spring
FILLING LEVEL MEASURING CONGRESS Location: Dusseldorf Sponsor: Gesellschaft fur Mess-und Regeltechnik Graf Reckestrasse 84, 4000 Dusseldorf 1 Germany Frequency: Annual	April	Spring
ACHEMA 1976, INTERNATIONAL TRADE FAIR FOR CHEMICAL APPARATUS Location: Frankfurt Fairgrounds, Frankfurt/M, Germany Sponsor: DECHEMA P.O. Box 970, Frankfurt/M Frequency: Biennial		June 20-26

EVENTS	1975	1976
IRAN		
INSTRUMENT AND CONTROL SYSTEMS EXHIBITION Location: U.S. Trade Center, Tehran Sponsor: U.S. Department of Commerce Washington, D.C. 20230 Contact: Country Marketing Manager—Iran Office of International Marketing, BIC Phone: (202) 967-3752	Sept.	
ISRAEL		
THE 9th CONVENTION OF ELECTRICAL AND ELECTRONICS ENGINEERS IN ISRAEL (with exhibit) Location: Yerid Hamizrakh Exhibition Gardens, Tel Aviv Sponsor: IEEE (Institute of Electrical and Electronics Engineers of Israel), P.O. Box 29234, Tel Aviv, Israel Frequency: Biennial	April 21-25	
TECHNOLOGY '75 (in conjunction with the TEL AVIV INTERNATIONAL TRADE FAIR) Location: Yerid Hamizrakh Exhibition Gardens, Tel Aviv Sponsor: Yerid Hamizrakh Exhibitions Co. Ltd. P.O. Box 21075, Tel Aviv 61210, Israel Frequency: Biennial	May 20-27	
ITALY		
INTERNATIONAL AUTOMATION AND INSTRUMENTATION CONFERENCE AND EXHIBITION Location: Milan Fair Ground, Milan Sponsor: FAST (Federazione Associazioni Scientifiche e Techniche) Piazza Morandi 2, 20100 Milan, Italy Studio A. Barbieri, Viale Premuda 20, 20129 Milan, Italy Frequency: Biennial		November
MAC '75 INTERNATIONAL CHEMISTRY EXHIBITION AND INTERNATIONAL SHOW OF INDUSTRIAL CHEMICAL PROCESSING EQUIPMENT Location: Milan Sponsor: MAC—'75, Via Tiziano 19, Milan Frequency: Annual	Nov. 6-12	Fall
JAPAN		
5th ALL JAPAN ANTI-POLLUTION DEVICES EXHIBITION Location: Nagoya Fukiage Hall Sponsor: Commerce Department, Nagoya City Office, 3-1-1 Sanromaru, Naka-Ku, Nagoya Frequency: Annual	Oct.	Fall

EVENTS	1975	1976
JAPAN—Continued		
'75 AUTOMATIC CONTROL EQUIPMENT SHOW AND '75 LABOR SAVING MACHINES EXHIBITION Location: Tokyo International Trade Fairgrounds Sponsor: The Industrial Daily News 1-8-10 Kudan Kita, Chiyoda-Ku, Tokyo Frequency: Annual	June 13-17	May
MECHANICAL AUTOMATION SHOW Location: Osaka International Trade Fair Sponsor: The Industrial Daily News Minato Fairgrounds; Osaka 2-1, Kyobashi, Maeno-cho, Higashi-Ku, Osaka Frequency: Annual	Sept. 1-7	Sept.
INSTRUMENTATION AND CONTROL ENGINEERING CONFERENCE Location: Dai-Tokyo Building—Tokyo Sponsor: Japan Management Association Kioritsu Building, Shiba Koen 25-gochi, Minato ku, Tokyo, 105 Frequency: Annual	Oct.	Oct.
JAPAN ELECTRIC MEASURING INSTRUMENT AUTOMATION EXHIBITION Location: Tokyo International Trade Fair Grounds, Tokyo Sponsor: Japan Electric Measuring Instruments Manufacturers Association, Keisoku Kaikan, 20, Kotohira-cho, Shiba, Minato-ku, Tokyo, 105 Frequency: Biennial	Nov.	
JAPAN ELECTRONICS SHOW Location: Minato Fairgrounds Sponsor: Electronic Industrial Association of Japan Tosho Bldg., 3-2-2 Marunouchi, Chiyoda-Ku, Tokyo Frequency: Biennial	Oct. 1-7	
'75 OSAKA INTERNATIONAL ANTI-POLLUTION EXHIBITION AND '75 SURFACE TREATMENT GENERAL EXHIBITION Location: Minato Fairgrounds Sponsor: Nihon Kogyo Shimbum, Osaka Branch, 27, Umeda Frequency: Annual	Nov. 5-10	November
KOREA		
6th KOREA ELECTRONICS SHOW Location: Ducksoo Palace Grounds, Seoul Sponsor: Korea Fine Instruments Center, 1.P.O. Box 2489, Seoul; 222-13, Kuro-dong; Yongdungpo-ku, Seoul Frequency: Annual	Oct.	Oct.

EVENTS	1975	1976
MEXICO		
MEASUREMENT AND CONTROL EQUIPMENT EXHIBITION AND SEMINAR Location: Mexico City Sponsor: Mexican Institute of Chemical Engineers Frequency: Annual	Fall	Fall
NETHERLANDS		
MACHEVO INTERNATIONAL PROCESS ENGINEERING EXHIBITION Location: Utrecht Sponsor: Royal Netherlands Industries Fair Jaarbeursplein, Utrecht Machevo Association, Koninginnegracht 15 The Hague Frequency: Every four years	Oct. 20-25	
PETROTECH '76 Location: Rai Exhibition Amsterdam Sponsor: Rai Gebouw B.V., Europaplein 8, Amsterdam Frequency: Biennial		April 6-9
HET INSTRUMENT EXHIBITION Location: Rai Exhibition, Amsterdam Sponsor: Dr. P. Felix, Het Instrument, Cooperative Vereniging U.A. Birkstraat 108, Postbus 152, Soest	Sept. 24-Oct. 2	Sept.
MILIEU—EXHIBITION FOR ENVIRONMENTAL CONTROL TECHNIQUES Location: Utrecht Sponsor: Royal Netherlands Industries Fair Jaarbeursplein, Utrecht Frequency: Biennial	Oct. 20-25	
SWEDEN		
INTERFOOD—FOOD TECHNOLOGY Location: Svenska Massan, Gothenburg Sponsor: Svenska Massan Stiftelse, Skanegatan 26 S41251 Goteborg Frequency: Biennial		Oct.
STOCKHOLM TECHNICAL FAIR Location: St. Eriks Fairgrounds, Stockholm Sponsor: AB St. Eriks Massan, S10680 Stockholm Frequency: Annual	Oct. 16-22	Oct.
SWITZERLAND		
INELTEC—EXHIBITION OF INDUSTRIAL ELECTRONICS AND ELECTRICAL ENGINEERING Location: Mustermesse, Basel Sponsor: Swiss Industries Fair, 4000 Basel, Switzerland Frequency: Biennial	Sept. 9-13	

EVENTS	1975	1976
SWITZERLAND—Continued		
SURFACE '75—INTERNATIONAL EXHIBITION FOR SURFACE TREATMENT Location: Basel Sponsor: Swiss Industries Fairs P.O. Box 4021, Basel Frequency: Triennial	Sept. 30- Oct. 4	
NUCLEX '75—INTERNATIONAL TRADE FAIR FOR INDUSTRIES Location: Basel Sponsor: Swiss Industries Fairs P.O. Box 4021, Basel Frequency: Triennial	Oct. 7-11	
MICROTECHNIC—INTERNATIONAL EXHIBITION FOR HIGH PRECISION TECHNIQUES, DIMENSIONAL MEASUREMENT & CONTROL Location: Zuespa Exhibition Grounds Sponsor: AGIFA/Fachmessen A.G. P.O. Box 257, 8033 Zurich Frequency: Biennial	Oct. 27- Nov. 1	
REPUBLIC OF CHINA (TAIWAN)		
TAIWAN ELECTRONICS SHOW '75 Location: China Sports and Culture Center, Taipei Sponsor: Taiwan Electric Appliance Manufacturers Assn. 7th Floor, Shih-Yeh Bldg., No. 9 Section 1 Chang An East Rd., Taipei Frequency: Annual	Nov.	Fall
INSTRUMENT EXHIBITION 1975 Location: Taipei Sponsor: China External Trade Development Council No. 145 Changshan North Road Section 1, Taipei Frequency: Annual	Nov.	Fall
UNITED KINGDOM		
IEA 11th INTERNATIONAL INSTRUMENTS ELECTRONICS AUTOMATION EXHIBITION Location: National Exhibition Center, Birmingham Sponsor: Industrial and Trade Fairs Ltd., Commonwealth House, New Oxford St., London W1 Frequency: Biennial	May 3-7	
ELECTRICAL ENGINEERING EXHIBITION Location: Belle Vue, Manchester Sponsor: Exhibitions for Industry Ltd. 157 Station Road East Oxted, Surrey Frequency: Biennial	June	

EVENTS	1975	1976
UNITED KINGDOM—Continued		
INTERNATIONAL PROCESS PLANT AND EQUIPMENT EXHIBITION Location: Olympia, London Sponsor: Industrial and Trade Fairs Ltd. Commonwealth House, New Oxford St., London W1 Frequency: Triennial	Sept. 8-12	
AUTOMATED PRODUCTION EXHIBITION Location: Belle Vue, Manchester Sponsor: Exhibitions for Industry Ltd. 157 Station Rd. East, Oxted, Surrey Frequency: Annual	Nov. 10-14	Nov.
REGULATING AND CONTROL INSTRUMENTATION AND EQUIPMENT EXHIBITION Location: U.S. Trade Center, London Sponsor: U.S. Department of Commerce Washington, D.C. 20230 Contact: Country Marketing Manager—U.K. Office of International Marketing, BIC Phone: (202) 967-3713		Feb.
ELECTREX (INTERNATIONAL ELECTRICAL ENGINEERS EXHIBITION) Location: Earl's Court, London Sponsor: Electrical Engineers Exhibition Ltd. Wix Hill House, West Horsley, Surrey		March

PENN STATE UNIVERSITY LIBRARIES
A000070952285